University of Alberta

The phenomenon of nonresponse in household telephone surveys: Trends and implications

by

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Abstract

Telephone surveys have become a widely-used research tool. However, rapidly declining response rates and the associated threat of nonresponse bias call into question the validity of data obtained through this method. The research presented in this thesis employs fifteen years of data (1991 – 2005) obtained from the Alberta Survey, an annual random-digit-dialed household telephone survey conducted by the Population Research Lab at the University of Alberta, to investigate the extent, nature, and implications of declining response rates. Trends in response rates and in the components of nonresponse are investigated as are changes in the degree of nonresponse bias present in five demographic variables, using the index of dissimilarity as a measure of bias. Results demonstrate a substantial decline in response rates and a corresponding increasing level of bias in variables related to respondent education and income. Implications of these results are investigated through poststratification analyses.

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Chapter 1. Household Telephone Surveys and Nonresponse: An Introduction to the Research Project

Overview of the Research Problem

While nonresponse in telephone surveys may appear, at first glance, a somewhat mundane topic for a research project, mentioning the subject in casual conversation suggests otherwise. It seems as though everyone has something to say about telephone surveys and why they do or, more often, why they do *not* participate in them. In short, telephone surveys have become a routine part of life for many Canadians and their presence has not gone unnoticed.

In fact, the now-ubiquitous nature of telephone surveys renders them difficult to ignore as they have become an important research tool used across academic disciplines, government agencies, and the private sector. The popularity of the telephone survey as a research method has burgeoned over the past 30 years, propelled by the development of new technologies such as random digit dialing (RDD) and computer assisted telephone interviewing (CATI) (Nathan 2001). A key strength of this method is its ability to reach a wide range of people across diverse geographic areas in a relatively short period of time, providing a cost-effective tool for obtaining information from large samples of people.

However, in order for telephone surveys to provide researchers with quality data they must accurately reflect the characteristics and views of the population sampled. That is, high quality data are those which are *representative* of the sample population. In general, as survey response rates increase, so does the representativeness of survey results. This

means that as potential respondents become nonrespondents – either because they refuse participation, they cannot be contacted, or there are other barriers to participation such as language problems – the potential for unrepresentative data increases. In other words, as nonresponse grows, so does the likelihood that *nonresponse bias* will affect survey data (Bethlehem 2002; Novo, Hammarstrõm and Janlert 1999; O'Neil 1979; Voogt and Van Kempen 2002).

Nonresponse bias can be understood as the difference between estimates of population characteristics and the population's true characteristics arising as a result of systematic differences between respondents and nonrespondents (see Berg 2005; Fowler 2002). In general, higher response rates reduce the likelihood that survey data will be affected by nonresponse bias (Bethlehem 2002; Novo, Hammarstrõm and Janlert 1999; O'Neil 1979; Voogt and Van Kempen 2002). This close relationship between response rates and representativeness of survey data is cause for concern as much of the survey research literature suggests that survey response rates are on the decline (see Curtin, Presser and Singer 2005; de Leeuw and de Heer 2002; de Leeuw and Hox 2004; de Leeuw, Lepkowski and Kim 2002; Goyder and Leiper 1985; Groves and Couper 1998; Groves et al. 2002; Novo, Hammarstrõm and Janlert 1999; O'Rourke et al. 1998; Steeh 1981; Steeh et al. 2001; Voogt and Van Kempen 2002).

It is this relationship between response rates and nonresponse bias that serves as the primary motivation for this study. The widespread use of telephone surveys as a data collection tool has already been articulated. When such prevalence is coupled with declining response rates, the potential for nonresponse bias to impact data also increases, thereby providing substantial cause for concern. Consider, for example, that in addition

to scholarly research which utilizes this method, data obtained through telephone surveys are used to shape government communications strategies (Page 2006) and for planning and decision-making processes in both the private and public sectors (see, for example, Gandy 2003; Gazso and Haggerty forthcoming; Herbst 1993; Tourangeau 2004). If the validity of data is threatened by nonresponse bias, the quality of resulting decisions is also called into question. Tremors from the impact of such bias have the potential to be felt from business strategic plans to academic programmes of research to government policy options and courses of action. Hence, declining response rates in telephone surveys and the associated threat of nonresponse bias are issues of vital importance that demand interrogation.

Social Trends Impacting Declining Response Rates

While the reasons for the decline in response rates to household telephone surveys are unclear, there are several social trends that can offer some explanation: trends related to privacy and confidentiality concerns; the growth of telecommunications technology; and the "over-surveying effect". While these are by no means the only factors, they are the contributing social trends that receive the most attention in the literature. This section presents a brief overview of the social context in which surveying takes place and how this context may account, in part, for the response rate trends we are witnessing.

Privacy and confidentiality concerns

In an age where technological development has rendered all kinds of information both easily accessible and easily exchanged, concerns about the erosion of personal privacy and threats to confidentiality have become commonplace (see, for example, Hinde 2001;

Lyon and Zureik 1996). Personal information has become a commodity, being gathered from sources such as "surveys, investigations, experiments, public records, and records of transaction" (Gandy 1996, 142). The fact that a "market for personal information" (Gandy 1996) exists can create a sense of uneasiness among privacy-conscious individuals, as well as a wariness of the methods by which this information is gathered – one of which Gandy (1996, 142) identifies as surveys.

While measuring privacy and confidentiality concerns is no easy task, as those with the most heightened concerns are the least likely to respond to requests for information (see Haggerty and Gazso 2005a), there is evidence to suggest that both Canadians and Americans feel that personal privacy is on the decline and that such a trend creates a sense of unease for many. For example, in a 1993 poll of 3000 Canadians conducted by Ekos Research Associates on behalf of the federal government and private financial institutions, 60% of respondents (response rate not reported) felt they had less personal privacy than was the case a decade earlier (Vienneau 1993). The same poll found that respondents felt "the least acceptable information seekers are telemarketers, survey companies and telephone companies" (Vienneau 1993), a finding that does not bode well for the survey research industry. Similarly, in an analysis of newspaper articles related to the decennial census, Goyder and Leiper (1985, 63) found that in Great Britain, the United States, and Canada, "criticism of the census on the grounds of privacy and confidentiality has increased in every decade from the 1930s to the 1980s".

Although these studies were both conducted over ten years ago, the results remain significant as concerns over privacy and confidentiality have by no means abated. In a recent article reviewing public opinion data (from 1990 to 2006) on privacy and

surveillance, Best, Krueger and Ladewig (2006, 383) found that "concern about threats to personal privacy has been growing in recent years". Moreover, following the terrorist attacks on the World Trade Center that occurred September 11, 2001, new measures of security and surveillance have burgeoned and thus have added a new dimension to debates around the limits of personal privacy (see Bennett and French 2003; Best, Krueger and Ladewig 2006; Gazso and Haggerty forthcoming; Haggerty and Gazso 2005b; Westin 2003).

Privacy- and confidentiality-related concerns are significant in the context of survey research. As Singer, Mathiowetz and Couper (1993, 466) suggest, "concerns about privacy go to the heart of a respondent's willingness to participate in a survey". This statement is corroborated by their research findings related to response to the 1990 United States census, as well as by findings based on response to the 2000 census (Singer, Van Hoewyk and Neugebauer 2003). The results of both studies suggest that attitudes toward confidentiality and privacy had a significant impact on mail returns of the census, even after controlling for demographic variables. Specifically, greater concerns resulted in reduced likelihood of returning census forms. Haggerty and Gazso (2005a) also speculate that individuals with heightened concerns over personal privacy are less likely to become survey respondents, either as a result of having an unlisted number, their possible increased use of call screening devices, or greater likelihood of refusal once contacted. In addition to those already mentioned, a number of other sources cite privacy concerns as a potential contributor to survey nonresponse (see American Statistical Association 1974; de Heer, de Leeuw and van der Zouwen 1999; DeMaio 1980; National Research Council 1979).

The relationship between privacy and confidentiality concerns and response to surveys grows in significance as the concerns themselves rise among the general populace. Thus, if individuals are in fact becoming more protective of their personal privacy and less willing to freely share personal information, survey research is likely to feel the repercussions in the form of declining response rates. The suggestion that heightened privacy- and confidentiality-related concerns are contributing, at least to an extent, to declining response rates remains speculative at this point in time and requires further research. Nonetheless, past and current trends do provide some support for the suggestion and it is a factor worth considering in studies of survey nonresponse.

Technological development

A second trend that may partially account for declining survey response rates involves technological developments in the area of telecommunications, particularly those that provide individuals with greater control over who is able to contact them. Specifically, answering machines, caller ID, and call blocking are frequently cited as technologies that impede access to potential respondents (see Curtin, Presser and Singer 2005; de Heer 1999; de Heer, de Leeuw and van der Zouwen 1999; de Leeuw, Lepkowski and Kim 2002; Dillman et al. 2002; Groves and Couper 1998; Haggerty and Gazso 2005a; Link and Oldendick 1999; Nathan 2001; Oldendick and Link 1994; O'Rourke et al. 1998; Page 2006; Piazza 1993; Steeh et al. 2001; Tourangeau 2004; Tuckel and Feinberg 1991; Tuckel and O'Neill 1996; Van Goor and Rispens 2004).

Such technologies "enable their owners to avoid or screen contacts with strangers" (Van Goor and Rispens 2004, 46) and, thus, their use could be linked to increases in the

number of noncontacts among potential survey respondents (Curtin, Presser and Singer 2005; Steeh et al. 2001). Individuals who do not wish to be contacted by survey researchers could either avoid answering calls from unknown numbers (Van Goor and Rispens 2004) or, alternatively, could avoid answering calls from a particular number subsequent to receiving a survey request originating from that source (Link and Oldendick 1999). There is some evidence suggesting that the use of these devices is increasing (Oldendick and Link 1994). In addition, a number of researchers feel that the threat posed to telephone survey research by these technologies will continue to grow in the future (see Steeh et al. 2001; Van Goor and Rispens 2004).

The greater availability and use of call screening technologies becomes even more problematic when one considers that "screeners" could be associated with a particular demographic profile. If this is indeed the case, it is possible that certain segments of the population are effectually screening themselves out of survey samples, thereby threatening the representativeness of survey data. However, the evidence for this hypothesis is mixed. Some studies suggest that individuals who own call screening devices tend to be younger (Oldendick and Link 1994; Tuckel and O'Neill 1996), of higher education (Oldendick and Link 1994; Piazza 1993), and white (Oldendick and Link 1994; Piazza 1993).[1] While ownership of such devices does not guarantee that they will be used to screen calls from survey researchers, the potential to do so does exist, thereby suggesting that their use may present a larger obstacle for certain population subgroups. On the other hand, two studies by Link and Oldendick (Link and Oldendick

[1] Note that Tuckel and O'Neill (1996) found that subscribers to caller ID are more likely to be African-American.

1999; Oldendick and Link 1994) found that age was the only factor significantly related to call-screening behaviour. Another study by Tuckel and O'Neill (1996, 40) found "little correspondence between the incidence of screening among those with caller ID and their attitudes toward survey participation," suggesting that caller ID may not pose as large of a threat to survey research as some imply. Further research is needed to clarify the role of call screening devices in survey nonresponse.

It is, however, highly probable that the use of these technologies is related, at least in part, to privacy and confidentiality concerns (see Haggerty and Gazso 2005a). That is, call screening and call blocking technologies offer users "enhanced privacy protection" (Groves and Couper 1998, 304) through the ability to restrict which individuals and/or organizations are able to contact them. Greater use of these devices by individuals with heightened privacy- and confidentiality-related concerns has the potential to impact survey representativeness. Continued growth of these concerns among the population could result in more widespread use of call screening devices and, thus, even greater impact on survey response rates.

It is likely that, in the future, further development of telecommunications applications will occur. New devices will become available and their use could add another dimension to the impact of technology on survey research. For example, the development of the "TeleZapper", a device designed to detect automatic dialing equipment and "'fool' the computer into thinking your number is disconnected", makes it difficult for many telemarketing companies to access individuals who are using the device (http://www.telezapper.com/default.asp). Similar developments may occur that could impact telephone survey researchers more directly. Technological development is

an ongoing process and, as such, is an area that requires continual monitoring by those interested in its impact on survey research.

The over-surveying effect

Finally, and somewhat ironically, the growth of the telephone survey as a research tool appears to be an important factor contributing to the challenges survey researchers are facing as a result of declining response rates. That is, many researchers suggest that potential respondents have become so inundated with survey requests that they are experiencing response "fatigue" and thus are less willing to participate in surveys (see de Heer, de Leeuw and van der Zouwen 1999; Goyder and Leiper 1985; Groves and Couper 1998; Haggerty and Gazso 2005a; Schleifer 1986). Sometimes termed the "over-surveying effect" (Groves, Cialdini and Couper 1992; Groves and Couper 1998), the requests for surveys have begun to surpass the resources that respondents are willing to devote to this form of research (see also Remington 1992).

Related to over-surveying is the increased number of unsolicited telephone calls that individuals now receive, thereby rendering potential respondents skeptical of calls originating from unknown numbers (Curtin, Presser and Singer 2005; de Heer, de Leeuw and van der Zouwen 1999; de Leeuw, Lepkowski and Kim 2002; O'Rourke et al. 1998). Telemarketing is a prime culprit, flooding the population with unwanted phone calls and, consequently, creating hostility toward unsolicited calls (de Leeuw and Hox 2004; Groves and Couper 1998; Nathan 2001; O'Rourke et al. 1998; Steeh et al. 2001; Tourangeau 2004). The marketing of the TeleZapper, whose website is peppered with slogans such as "Keeps telemarketers out" and "Get the TeleZapper and eliminate many

of those unwanted telemarketing calls!", provides an indication of the population's increasing frustration with these kinds of calls (http://www.telezapper.com/default.asp).

Similarly, the establishment of national 'Do Not Call' registries in the United States and Canada is sending the message that people are simply fed up with marketing calls. These registries enable individuals to add their name to a national list to stop phone calls from marketers representing businesses and some other organizations (CBC 2004). Such a registry was established in the United States in 2003 by the Federal Communications Commission, and one source suggests that "as many as 100 million household phone numbers are on the American registry" (Cordon 2006).[2] A national Do Not Call registry, legislated under Bill C-37, is currently in the process of being established in Canada by the Canadian Radio-television and Telecommunications Commission (CRTC) which is also responsible for regulating Canadian telephone companies (CBC 2004; Industry Canada 2005). At the time this thesis was written, the rules and exemptions for the Canadian registry had not yet been finalized.

Such developments clearly demonstrate the frustration that Canadians, and North Americans more generally, are experiencing with unsolicited phone calls. It is likely that these frustrations spill over to the realm of telephone survey research with potential respondents viewing survey requests as simply adding to the burden of unwanted phone calls they are forced to deal with.

Due to the overabundance of telephone calls in most households, the issue of the *legitimacy* of surveys has become paramount. That is, if individuals contacted are to

[2] It seems highly unlikely that 100 million households in the United States have added their phone numbers to the American Do Not Call registry. However, even if the numbers are not as high as reported by Cordon (2006), they nonetheless are indicative of the huge public support for this kind of initiative.

become survey respondents, it is important that they feel the survey they are being asked to participate in is a legitimate one deserving of their time and effort (de Heer, de Leeuw and van der Zouwen 1999; de Leeuw and Hox 2004; de Leeuw, Lepkowski and Kim 2002; Groves and Couper 1998; see also Steeh et al. 2001). However, the ability of valid survey research organizations to establish this kind of legitimacy is undermined by the misleading practices that some telemarketing firms choose to follow. Namely, "selling under the guise of survey research" or "fundraising under the guise of survey research", sometimes termed SUGGING and FRUGGING, respectively (Groves and Couper 1998; Remington 1992), creates skepticism about all survey requests and makes it very difficult to establish legitimacy (de Leeuw and Hox 2004; Groves and Couper 1998; Remington 1992; Schleifer 1986). The adoption of these approaches by some telemarketing organizations reflects negatively on all survey requests and has doubtless had a negative impact on telephone survey response rates.

Frustration with over-surveying and inundation with unsolicited telephone calls is likely linked not only to refusals to respond to surveys, but also to the use of the call screening devices discussed above. If an individual screens out all unknown or suspect numbers, any opportunity for survey organizations to establish legitimacy and potentially gain response is eliminated. Thus, surveys themselves are subject to the influence of the activities of other organizations and industries, and currently this influence appears to be harmful rather than helpful.

Survey-taking climate

The social forces and trends discussed thus far combine and interact to form what is often called the survey-taking climate (see de Heer 1999; de Leeuw and de Heer 2002; Dillman et al. 2002; Groves, Cialdini and Couper 1992; Groves and Couper 1998). The survey-taking climate encompasses all of the elements that affect how surveys operate and are viewed within society. It is important to note that this climate is not limited to the three trends already discussed, but also includes broader factors such as the perceived legitimacy of societal institutions, the degree of social cohesion within a society, and the extent to which citizens experience feelings of social responsibility (Groves and Couper 1998, 31). The concept of the survey-taking climate is an important one as it recognizes how broader social, political, and cultural forces contribute to survey response trends. Surveys are not administered within a vacuum and their respondents are not free from the influences of the societies in which they live. Rather, survey administration and participation are embedded within a broad socio-political context, and the role of this context should form an important component of survey response research.

Project Aim and Scope

It has already been established that response rates to household telephones surveys are declining, and that this decline is likely the result of the interaction of a number of social forces and trends. Thus, the primary aim of this research project is to investigate the *extent and nature* of this decline in a Canadian context, as well as the *implications* of declining response rates. The project is guided by two overarching research questions:

1. How have nonresponse rates to household telephone surveys changed over time (what is the extent/nature of the decline)?

2. How do nonresponse rates in household telephone surveys affect nonresponse bias (what are the implications of declining response rates)?

The first question provides the contextual foundation for the research by examining trends in response and nonresponse rates, and is explored fully in Chapter 2. The second research question interrogates the implications of nonresponse by investigating the relationship between nonresponse rates and nonresponse bias. This question examines the significance of declining response rates, why researchers should (or should not) be concerned about them, and is addressed in Chapters 3 and 4.

It is important to note that this study focuses solely on response rates to cross-sectional household telephone surveys where the survey sample is obtained through random digit dialing (RDD) techniques, as opposed to other survey designs such as those targeted at restricted populations (e.g., associations or occupational groups), longitudinal or panel studies, and those using other data collection methods (e.g., mail surveys). Household RDD surveys constitute a distinct type of survey (see Goyder and Leiper 1985), and thus it would be inappropriate to generalize to other survey designs and methods.

It is also necessary to clearly articulate what is meant by "nonresponse" in this study. There are two broad categories of nonresponse in survey research: item nonresponse and unit nonresponse. The former refers to instances where a survey respondent does not answer particular questions (or items) within a survey, while the latter occurs when the person, household, or organization that constitutes the sample unit does not respond to the survey itself (Dillman et al. 2002, 3). This study focuses on *unit nonresponse* rather than item nonresponse.

There are various forms of nonresponse within the category of unit nonresponse. The most common typology in the literature, and the one that has been adopted in this study, includes three elements: refusals; noncontacts; and other noninterviews (Collins et al. 1988; Curtin, Presser and Singer 2005; Dillman et al. 2002; Groves and Couper 1998; Voogt and Van Kempen 2002). Refusals occur when the selected sample unit is contacted but declines participation in the survey, while noncontact refers to situations where the desired respondent cannot be reached. Other noninterviews result from circumstances which prohibit selected sample units from participating in the survey, for example, as a result of language barriers, health issues, or mental disabilities. Each of these three elements of unit nonresponse is considered in the following chapters.

The Data Set

The data employed to investigate the research questions outlined above were obtained through the Alberta Survey, an annual omnibus household telephone survey that has been conducted by the University of Alberta's Population Research Lab (PRL) since 1987.[3] The Alberta Survey is a survey of Alberta adults where households are selected through random digit dialing. Each year approximately 1200 Alberta adults are included in the sample – 400 from each of three geographic areas: Edmonton, Calgary, and Other Alberta. The survey includes research questions contributed by both university researchers and researchers from other organizations. The questions interrogate a wide

[3] The Population Research Lab at the University of Alberta is a social science research centre that conducts research in the areas of social policy, health, population, education, and public opinion (http://www.uofaweb.ualberta.ca/prl/).

range of issues related to public policy, although the specific subject matter of the survey varies from year to year.[4]

Alberta Survey data from the years 1991 to 2005 were used in the analyses presented in this thesis. Although the Alberta Survey has been administered since 1987, 1991 was the first year where all regions included in the sample were surveyed by telephone. Prior to 1991, data from respondents residing in Edmonton were collected via face-to-face interviews. Thus, data from the first four years of the Alberta Survey are excluded from analyses in order to ensure that the reported changes in response and nonresponse rates are not a result of altering the data collection method used.

Why this Thesis?

There is already a large body of research that focuses on changes in response rates over time as well as on the relationship between response rate and quality of data. So what makes this research project unique and why is it important? There are five primary reasons why this thesis is important, each of which is outlined briefly below.

1. Cross-national replication

First, the majority of the current research on this topic focuses on the United States, and, to a lesser extent, on countries such as Sweden (see Novo, Hammarstrõm and Janlert 1999) and The Netherlands (see Voogt and Van Kempen 2002). Research on

[4] All information on the Alberta Survey was obtained from http://www.uofaweb.ualberta.ca/prl/AlbertaSurvey.cfm, retrieved February 27, 2006. Additional information on the Alberta Survey can be obtained from this website.

nonresponse in telephone surveys conducted in Canada is comparatively sparse,[5] and often it is included as a component of larger studies carrying out comparisons across countries rather than really focusing on the Canadian context (see, for example, de Heer 1999).

So, why is it problematic that the majority of research on nonresponse in telephone surveys is American rather than Canadian-based? What is different or distinct about Canada when compared to the United States that results in the need for Canadian-based research on this phenomenon? While a brief review of the literature does not provide evidence for hard and fast differences between the two countries and, in many cases, suggests that the countries may in fact be more similar than different, there are some small but potentially significant divergences which could influence survey response behaviour.

First, there appear to be some differences between Canadian and American voluntary association membership. Specifically, when background variables are controlled for and both union and religious association membership (which may be less voluntary than involvement in other types of organizations) are excluded from the analysis, "working membership"[6] rates in voluntary associations are significantly higher in Canada than in the United States (Curtis, Grabb and Baer 1992, 147). As responding to a survey is

[5] There is some Canadian research on survey response rates. For example, Goyder and Leiper (1985) examine survey response rate trends in Canada, Britain, and the United States, although they focus solely on mail and face-to-face surveys to the exclusion of telephone surveys. In addition, Goyder (2005, 7) mentions falling response rates in the Canadian National Election study and makes reference to the "difficult survey culture of recent years".

[6] Analysis based on "working memberships" excludes nominal or inactive members of voluntary associations (Curtis, Baer and Grabb 2001, 784).

essentially a voluntary activity, active membership in voluntary associations may be related to willingness to respond.

Second, surveys themselves can be seen as a form of surveillance and can be impacted by privacy concerns (Haggerty and Gazso 2005a). Thus, we would expect that attitudes toward privacy, security, and surveillance issues could influence survey participation and, consequently, that national differences in these areas may have implications for survey response rates. The literature indicates that prior to the attack on the World Trade Center on September 11, 2001 (hereafter referred to as 9/11), privacy protection policy in Canada was becoming increasingly divergent from, and more progressive than, that of the United States (Bennett and French 2003). However, following 9/11 substantial changes have occurred in the areas of surveillance and security in both Canada and the US (Haggerty and Gazso 2005b). To date there is little existing literature providing comparison of current trends related to surveillance, security, and privacy between the two countries. Despite the dearth of information in this area it is reasonable to assume that, based on pre-9/11 trends, there are likely still differences between Canada and the US regarding privacy policy even if the two countries have converged to some extent.

In addition, there is some evidence to suggest that Canadians express higher levels of social trust than do Americans (Moon, Lovrich and Pierce 2000). It is possible to speculate that social trust may be related to perceived legitimacy of institutions involved in survey administration and/or sponsorship, and therefore may impact response rates. Thus, while Canadian-American cultural and political differences/similarities remains an

area of much scholarly debate, there is some evidence suggesting the existence of national differences which could impact the level of survey participation.

The existence of national differences in response rates is supported by earlier work comparing nonresponse to mail and interview surveys in Canada and the United States (Goyder 1985), although this difference is in the opposite direction of that suggested above. This research found that response rates in Canada were on average ten to fifteen percentage points lower than those obtained in comparable surveys conducted in the US, and seven of these percentage points were *not* attributable to differences in number of callbacks (Goyder 1985, 245). Such findings suggest the presence of certain national differences contributing to differential response behaviour and thereby support the need for Canadian-based research on survey nonresponse.

2. Focus on a non-governmental survey

Next, the research that does employ at least some Canadian data is based largely on government surveys (see de Heer 1999; Groves and Couper 1998; Smith 1995) which tend to achieve a higher response rate than do surveys conducted by universities and private survey research firms (de Heer 1999; Groves and Couper 1998), thereby limiting the generalizability of such work (Smith 1995). My research will begin to bridge this gap by analyzing the problem of nonresponse through the use of data obtained in an Alberta-based telephone survey conducted by a university research lab.

3. Unique measure of nonresponse bias

Third, this research project uses a unique measure of nonresponse bias. The index of dissimilarity, while often employed in segregation studies, has not yet been used widely

in the capacity in which it is here, that is, in the measurement of nonresponse bias.[7] Thus, the study presents another approach to measuring nonresponse bias that has the potential to be adopted in future research projects.

4. Longitudinal analysis of bias

Fourth, this study is important, and somewhat unique, in that it measures changes in both the magnitude and direction of nonresponse bias over time across a variety of dimensions. Rather than focusing on the bias present in a survey at a single point in time, this study extends such an analysis to obtain a longitudinal picture of how bias has changed from 1991 to 2005.

5. Examination of the implications of bias for particular survey items

Finally, the analyses employed in this study provide a clear illustration of how nonresponse bias can impact specific survey items. Through an examination of a variety of survey items, the implications of bias are moved from an abstract theoretical level to one that is more accessible and concrete.

Thus, this research will be among the first to provide a thorough investigation of a non-governmental Canadian case study of nonresponse in household telephone surveys. By drawing on a significant data set that spans a decade and a half, robust longitudinal analyses are possible and form a key component of the current study. The analyses undertaken to examine nonresponse bias employ a measurement tool relatively

[7] The index of dissimilarity has been used by the Population Research Lab at the University of Alberta to provide an indication of the representativeness of Alberta Survey data along the dimensions marital status and age since 1989 (see, for example, Population Research Lab 1991 – 2005). However, from 1997 to 2005 the index of dissimilarity was only computed for age.

uncommon in the area and are extended to cover a period of time more expansive than has been the case in most previous studies. While nonresponse itself is a well-established area of research, the specific components of this study provide an important contribution to the field.

Theoretical Framework

A "multilevel conceptual framework" of survey participation that was first clearly articulated in the work of Groves and Couper (1998, 25) has provided the groundwork for this research. The core assumption underlying this framework is that surveys are administered within particular social and cultural contexts, involve a particular form of social interaction between specific individuals, and are characterized by particular features, all of which influence survey response/nonresponse. While the basic concepts outlined by Groves and Couper (1998) provide the foundation for my theoretical framework (Figure 1.1), they are substantially modified (the original conceptual framework developed by Groves and Couper can be found in Appendix A).

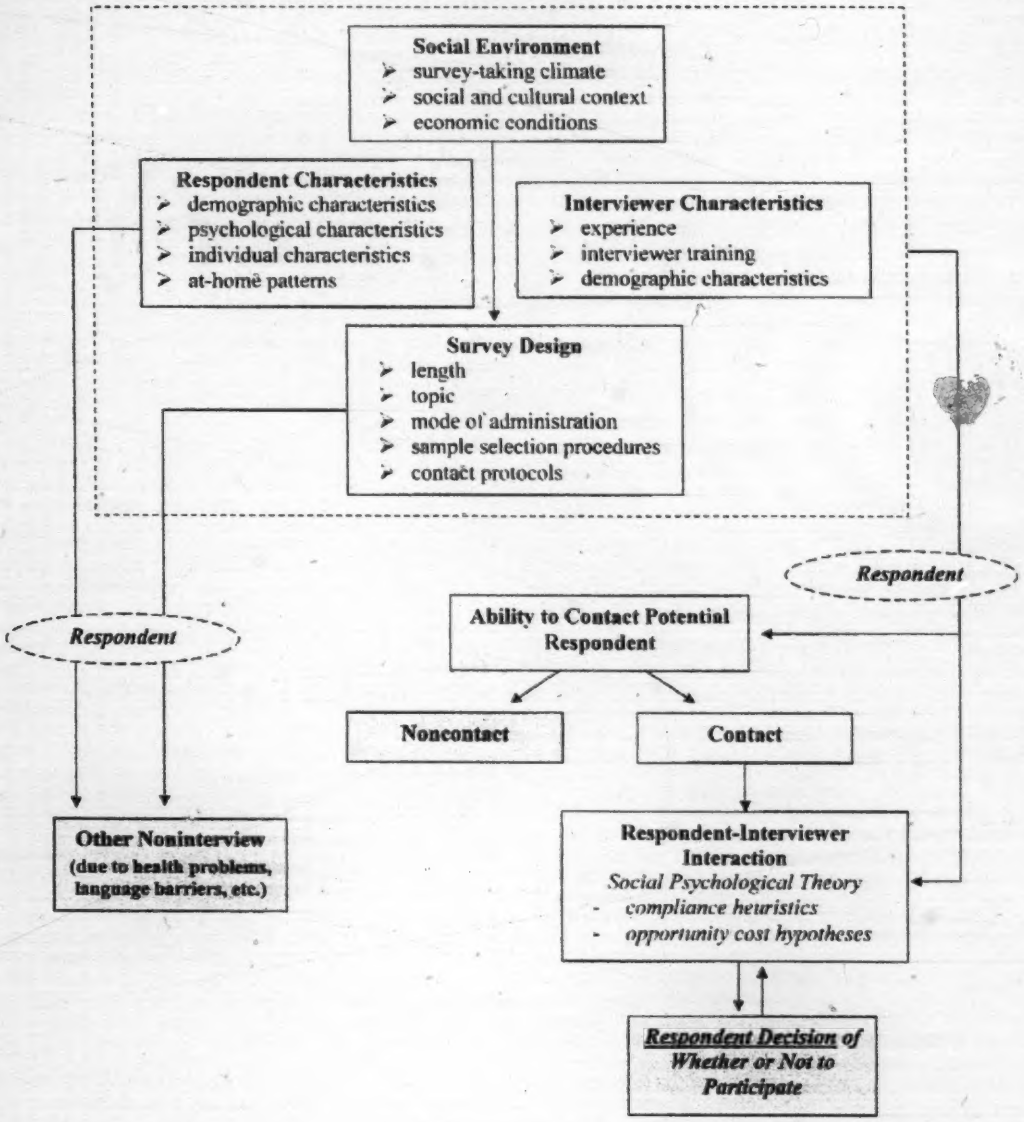
In the original version of the framework, the authors distinguished between factors that are within and outside of researcher control (Groves and Couper 1998). However, I omit that portion of their framework and instead present the factors in terms of 'levels of influences' contributing to survey participation that ultimately result in respondent participation or non-participation. I do so because I believe that it is the *process* of survey participation which provides the greatest understanding of nonresponse. While level of researcher control over particular components has important practical

implications, I do not consider it essential for a theoretical understanding of the process of survey participation.

In addition, the ability of an interviewer to contact a potential respondent has been made explicit in my framework. As nonresponse can occur through either refusal, noncontact, or as a result of other circumstances (other noninterview), it is important to clearly delineate how types of nonresponse fit within the conceptual framework.

At the broadest level of the conceptual framework (Figure 1.1), social environmental characteristics such as the survey-taking climate (e.g., the degree to which surveys are perceived as legitimate within society), economic conditions, and the social and cultural context in which a survey is conducted influence survey participation (de Heer 1999; de Leeuw and de Heer 2002; Groves, Cialdini and Couper 1992; Groves and Couper 1998; Johnson et al. 2002). The next level in the framework is comprised of respondent and interviewer characteristics and interviewer experience and training, all of which have been shown to have an impact on respondents' decisions of whether or not to cooperate with a survey request (see, for example, Groves and Couper 1998; Groves and Lyberg 1988; Singer, Frankel and Glassman 1983). Specific survey design features constitute the third level of the framework. Survey length, mode of administration, sample selection procedures, and survey topic are all features specific to individual surveys that may influence respondents' decisions to participate (see de Leeuw and de Heer 2002; Dillman et al. 2002; Groves and Couper 1998; Groves and Lyberg 1988; Groves, Presser and Dipko 2004). These three levels then influence both the ability to contact a potential respondent and the interaction between respondent and interviewer, ultimately culminating in noncontact, other noninterview, or a decision of whether or not to

Figure 1.1. Conceptual framework of survey participation



participate in the survey (Groves, Cialdini and Couper 1992; Groves and Couper 1998).

The potential survey participant occupies a central role in the proposed framework as the respondent is understood as an active individual who participates in the survey process. The outcome of attempted contact with a potential respondent is not merely the result of societal conditions, respondent and interviewer characteristics, and survey design features, but rather these conditions are in a sense 'funneled through' the potential respondent. Indeed, the potential respondent is an individual with agency and an active participant in the survey process in a manner that goes beyond the moment that the decision is made of whether or not to participate in a survey. For example, while situated in a particular socio-political context, it is the individual who makes the decision to answer a call when an unknown number appears on the call screening device. On another level, the potential respondent plays a key role in structuring the respondent-interviewer interaction that takes place—the individual is not a passive subject in this brief relationship. As such, the role of the potential respondent as an active individual is made explicit in my conceptual framework.

The foundation for this framework rests in the very nature of the survey process. That is, survey participation, and the process of requesting respondent participation in a survey, is inherently a social process (Goyder and Leiper 1985; Groves, Cialdini and Couper 1992; Groves and Couper 1998; Johnson et al. 2002) involving a relationship between a potential respondent and a researcher/interviewer. The "active participation of sample persons" in the survey process and thus their involvement in the respondent-researcher relationship is essential to the integrity of survey research (Groves et al. 2002, xiii).

The respondent-interviewer interaction is also a crucial component of the conceptual framework. As such, social psychological behavioural and cognitive theories concerned with social interaction and decision-making processes have an important role to play in the theory of survey participation which underlies the phenomenon of nonresponse: "In order to understand the statistical implications of nonresponse, we must understand its behavioural bases" (Groves and Couper 1998, 25).

It is at this point that heuristic principles governing decisions related to compliance with requests enter into the framework. In particular, six relevant heuristic principles are identified in the literature as potential influencers of respondent decisions of survey participation: reciprocation, consistency, social validation, authority, scarcity, and liking (Cialdini 1988 cited in Groves, Cialdini and Couper 1992; see also de Leeuw, Lepkowski and Kim 2002). Briefly, the meaning of each as explicated in Groves, Cialdini and Couper (1992, 480-483) is as follows:

1. Reciprocation: Individuals are more likely to comply with a request if it is perceived as repayment for a gift or favour.

2. Consistency: Individuals are more likely to comply with requests for behaviours consistent with a position adopted.

3. Social Validation: If an individual believes that others similar to them would comply with a request, they are also more likely to comply with it.

4. Authority: If a request comes from a source that is perceived as a "legitimate authority", compliance is more likely. Note that the concept of *legitimacy* is integral to the authority heuristic – a concept which is important in the survey nonresponse literature (see de Leeuw and Hox 2004; de Leeuw, Lepkowski and Kim 2002; Steeh et al. 2001).

5. Scarcity: Opportunities that are perceived as more scarce are also perceived as more valuable (Mazis 1975 and Worchel, Lee and Adewole 1975 cited in Groves, Cialdini and Couper 1992, 483), and thus greater perceived scarcity leads to a greater likelihood of compliance with a

request. This heuristic is intrinsic to the hypothesis that over-surveying is leading to a decline in response rates.

6. Liking: If the source of the request is liked (interviewer or sponsoring organization), individuals should be more likely to comply with it.

These heuristic principles operate in conjunction with other factors that can be viewed as part of "opportunity cost" hypotheses which suggest that "a prospective survey respondent weighs all the costs of participation against the benefits of participation" (Dillman et al. 2002, 8). For example, perceived burden and evaluation of perceived benefits versus perceived costs are factors which likely enter into the final respondent decision of cooperation or non-cooperation (see Dillman 1978; de Leeuw, Lepkowski and Kim 2002).

Related to the "opportunity cost" hypothesis is the "leverage-saliency" theory of survey participation, put forth by Groves, Singer and Corning (2000). Leverage-saliency theory emphasizes the role played by various survey features in securing survey participation. Specifically, the theory asserts that survey participation is a function of both how important particular survey features are to potential respondents (the "leverage" of the features, such as presence of incentives or the survey topic), and of the extent to which those features are emphasized during the survey request (the extent to which they are made "salient").

Note that the leverage assigned to particular features can act in a positive or negative way (Groves, Singer and Corning 2000). As survey features holding greater leverage are made more salient, they are more likely to sway survey participation in either a positive or negative direction, depending on whether those particular features are viewed as positive or negative attributes by the potential respondent. Thus, leverage-saliency

theory assumes a relative cost-benefit model, where the role played by various desirable or undesirable survey elements (i.e., either costs or benefits) is dependent upon both the importance of those elements to the potential respondent and the extent to which they are emphasized in the survey request.

In sum, the comprehensive framework I have detailed proposes that a true understanding or investigation of the phenomenon of nonresponse requires recognition of the potential impact of all the various levels of influential factors. This multi-level framework acknowledges the complexity of the phenomenon of survey nonresponse as each component speaks to particular aspects of the survey process. By distinguishing between nonresponse resulting from noncontact, nonresponse resulting from other noninterview, and nonresponse resulting from refusal (decision of whether or not to participate), the framework recognizes that these are distinct outcomes likely influenced by unique factors at each of its composite levels.

With this theoretical groundwork established, I will now move to a discussion of nonresponse trends. In Chapter 2, I will first focus on the question of how response rates have changed over time. I will then examine the extent and nature of the decline in the various components of nonresponse in the Alberta Survey over the time period from 1991 to 2005.

Chapter 2. Trends in Household Telephone Survey (Non)response Rates: How Low Can We Go?

Concern over the implications of declining response rates in household telephone surveys provided the motivation for this research project. Hence, a thorough investigation of trends in response rates serves as an important entry point into the research. This chapter lays the foundation for the remainder of the study, answering the first research question: *How have nonresponse rates to household telephone surveys changed over time?* The chapter begins with a brief review of the literature focusing on trends in response and nonresponse rates followed by an investigation of such trends in the Alberta Survey and, finally, comparison of these trends to what is occurring in other surveys.

Each of the three components of nonresponse – refusal, noncontact, and other noninterview – are considered separately in this chapter as the composition of nonresponse can have important implications for nonresponse bias. That is, there may be systematic differences between refusers, noncontacts, and other noninterviews which can impact survey results (Goyder 1987; Groves and Couper 1998; Lynn and Clarke 2002; Lynn et al. 2002; Smith 1983; Van Goor and Rispens 2004; Voogt and Van Kempen 2002). Consideration of each of these three components independently will enable a more thorough investigation of nonresponse throughout the remainder of the study.

Looking to the Literature: Trends in household telephone survey response rates

The vast majority of studies of telephone survey nonresponse suggest that response rates are declining[8] (see Curtin, Presser and Singer 2005; de Leeuw and de Heer 2002; de Leeuw and Hox 2004; de Leeuw, Lepkowski and Kim 2002; Goyder and Leiper 1985; Groves et al. 2002; Groves and Couper 1998; Novo, Hammarstrõm and Janlert 1999; O'Rourke et al. 1998; Steeh 1981; Steeh et al.; Voogt and Van Kempen 2002) and that this is not a new phenomenon (de Heer 1999; de Leeuw and de Heer 2002; Steeh 1981). For example, de Leeuw and de Heer (2002, 41) state that "survey nonresponse is as old as survey research itself". Studies published in the late 1970's allude to the increasing difficulty of obtaining high response rates experienced by survey organizations at that time (see American Statistical Association 1974; O'Neil 1979; Wiseman and McDonald 1978).

However, while low response rates have been an ongoing concern amongst survey researchers, "trend studies suggest that participation in surveys is declining over time" and that nonresponse is "indeed an increasing problem in the developed world" (de Leeuw and de Heer 2002, 41, 52; see also Groves et al. 2002). That is, although response rates have been declining for some time, research suggests that there has been a much sharper decline in this trend recently, resulting in a situation of greater urgency. Moreover, there is widespread concern that the increase in survey nonresponse is a trend that will continue (de Heer, de Leeuw and van der Zouwen 1999; Groves and Couper

[8] There is a small amount of evidence which suggests that "trends in nonresponse go in various directions" (Smith 1995, 168).

1998; Steeh et al. 2001), thereby posing an increasingly significant threat to the validity of survey research.

The literature is less clear as to which component(s) of nonresponse are the greatest contributors to declining response rates. Much of the research recognizes that both refusals and noncontacts play a significant role in nonresponse (Bradburn 1992; Curtin, Presser and Singer 2000; de Heer 1999; de Leeuw and de Heer 2002; Drew, GTE Laboratories and Groves 1989; Groves and Couper 1998; Keeter et al. 2000; Steeh et al. 2001; Tourangeau 2004), and some suggests that the respective contributions of these two forms vary across time (Steeh et al. 2001) and place (de Heer 1999; de Leeuw and de Heer 2002). While one study proposes that the nature of nonresponse is shifting from primarily refusals to a combination of refusals and noncontacts (Steeh et al. 2001), rising refusal rates continue to be lamented not only in academic research, but also by private survey research firms (see Allen 2001) and the mass media (see, for example, Carmichael 2004).

As mentioned in the introductory chapter, the majority of the current literature on telephone survey nonresponse does not focus specifically on the Canadian context, and the research that does employ at least some Canadian data is often based largely on government surveys (see de Heer 1999; Groves and Couper 1998; Smith 1995). To begin to bridge this gap, and to examine nonresponse trends in a non-governmental Canadian context, I now turn to a discussion of the Alberta Survey and how its response rates have fared over time.

Methods

Data on response rates were obtained from *Alberta Survey Sampling Reports*, prepared annually by the Population Research Lab. The Sampling Reports for the years 1991 to 2005 (inclusive) were examined. The Reports detail the proportion of eligible households[9] receiving final call disposition codes that correspond to one of the following six categories (Population Research Laboratory 2005):

1. completed interviews,
2. incomplete interviews,
3. refusals,
4. language problems,
5. not available, and
6. no contact.

The response rate is then determined according to the following formula (including eligible numbers only):[10]

$$\frac{\text{completed interviews}}{\text{completed + incomplete + refusals + language problems + not available + no contacts}}$$

Nonresponse rates including refusal rates, noncontact rates, and other noninterview rates were determined using a slightly modified version of the formula presented above. Specifically, calls with the final disposition under analysis were moved to the numerator of the equation. For example, to calculate the refusal rate the calls coded as "refusals" were moved to the numerator (but still included in the denominator as well).

[9] Telephone numbers that are non-residential or not in service are considered ineligible and are excluded from response rate calculations. The Alberta Survey Sampling Reports distinguish between eligible and ineligible numbers in the data they present.

[10] The PRL also employs a second method of calculating response rates, one in which "no contact" and "not available" dispositions are omitted from the denominator, thereby resulting in a higher response rate (Population Research Laboratory 2005, 7), or rather, *cooperation rate*.

Calls with the final disposition of either "not available" or "no contact" were combined into a single call disposition category labeled "noncontact" for the purposes of this research. The "not available" disposition did not appear in Sampling Reports until 1999, and it was combined with the calls coded as "no contact" due to the similarity with which these two dispositions were defined. The 1999 Sampling Report (5) indicates that "not available" includes "those who were not available at a verified residential number (e.g., away on vacation, temporarily in hospital, etc.)". However, the 1998 Sampling Report (9) provides an almost identical definition for the disposition "no contact", stating that it includes "those who could not be contacted at a verified number for whatever reason (e.g., away on vacation, never at home when called, temporarily in hospital, etc.)". Thus, it is assumed that prior to 1999 the calls that could have been coded as "not available" were lumped into the "no contact" category. As a result, combining data for sample units assigned either of the two call dispositions into a single category simplifies the required calculations without compromising the integrity of the results.

The other noninterview rate was calculated by combining sample units with the final call disposition "incomplete interview" or "language problems" into a single category. Note that in some years of the Alberta Survey, a seventh call outcome category referring to illness or health issues was included in the Sampling Reports. Calls with this disposition were also included in the other noninterview rate.

Findings: Trends in Alberta Survey response rates and nonresponse rates

Overall trends in response rates and the components of nonresponse for the Alberta Survey from 1991 to 2005 are summarized in Figure 2.1. This figure provides important

context for the remainder of the study and serves as a critical component of much discussion throughout this chapter.

Figure 2.1. Alberta Survey call disposition rates: 1991 – 2005 [11]

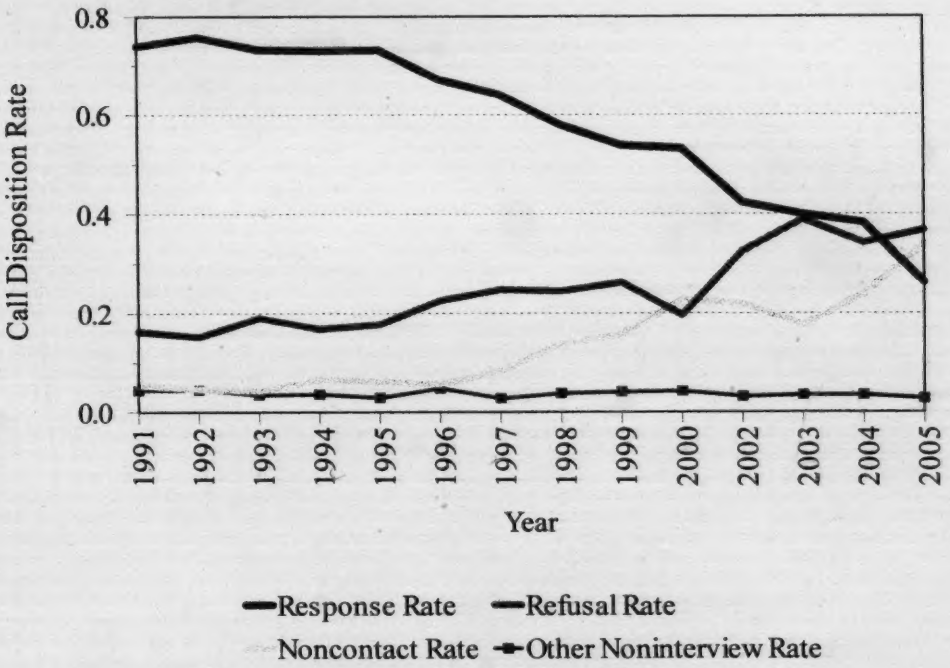


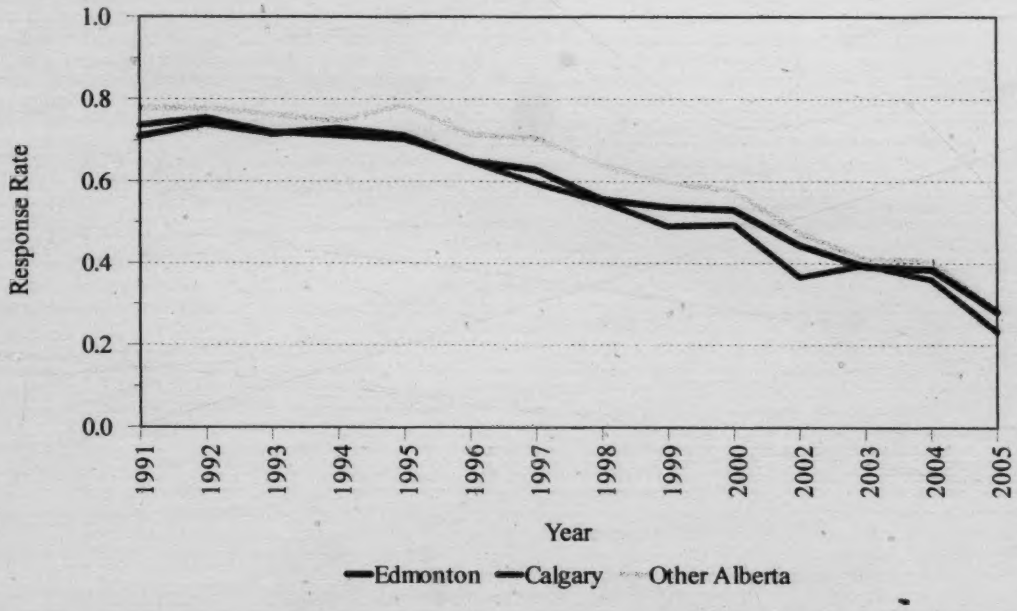
Figure 2.1 clearly demonstrates a steady decline in response rates, particularly since the mid-nineties, mirrored by a rise in both refusals and noncontacts. The Alberta Survey response rate dropped from 74% in 1991 to only 26% in 2005 – a substantial decline of 48%. Refusal rates more than doubled over the same time period, beginning at 16% in 1991 and rising to 37% by 2005. Noncontact rates experienced an even greater increase, starting from 5% in 1991 and increasing almost seven times to 34% in 2005. On the

[11] In 2001 the Population Research Lab did not conduct the Alberta Survey, and hence there is no data available for that year. In addition, in 1995 and 1996 the Alberta Survey was conducted in three and two segments respectively (each segment consisting of approximately 1200 respondents) due to the large number of questions submitted by researchers. Thus, data from the first iteration of the Alberta Survey for both 1995 and 1996 were used for all analyses as the time of year the first iterations were conducted corresponded most closely with the time of year that previous Alberta Surveys were administered.

other hand, the other noninterview rate remained fairly consistent from 1991 to 2005 and did not show any overall upward or downward trend. A more detailed discussion of these trends follows presentation of Figures 2.2 through 2.5, where each of the trend lines depicted in Figure 2.1 is further broken down by region (Edmonton, Calgary, and Other Alberta).

Response and nonresponse trends by region

Figure 2.2. Response rates by region: 1991 – 2005



It is evident from Figure 2.2 that the decline in Alberta Survey response rates is not due to unwilling or unavailable respondents in a single area, but rather is a phenomenon experienced across the province. The trend lines for response rates follow roughly the same pattern in all three regions, with the steepest decline seen from the mid-nineties on. In all three regions the decline becomes even more pronounced from 2004 to 2005. Note, however, that the response rates tend to be slightly higher in the "Other Alberta" region –

a region that includes smaller cities and towns, as well as more rural areas – than they are for the higher-density urban centres of Edmonton and Calgary. This finding supports prior research suggesting that residents of rural areas and smaller towns tend to be somewhat more amenable to survey participation (DeMaio 1980; Groves and Couper 1998; Smith 1983).

Figure 2.3. Refusal rates by region: 1991 – 2005

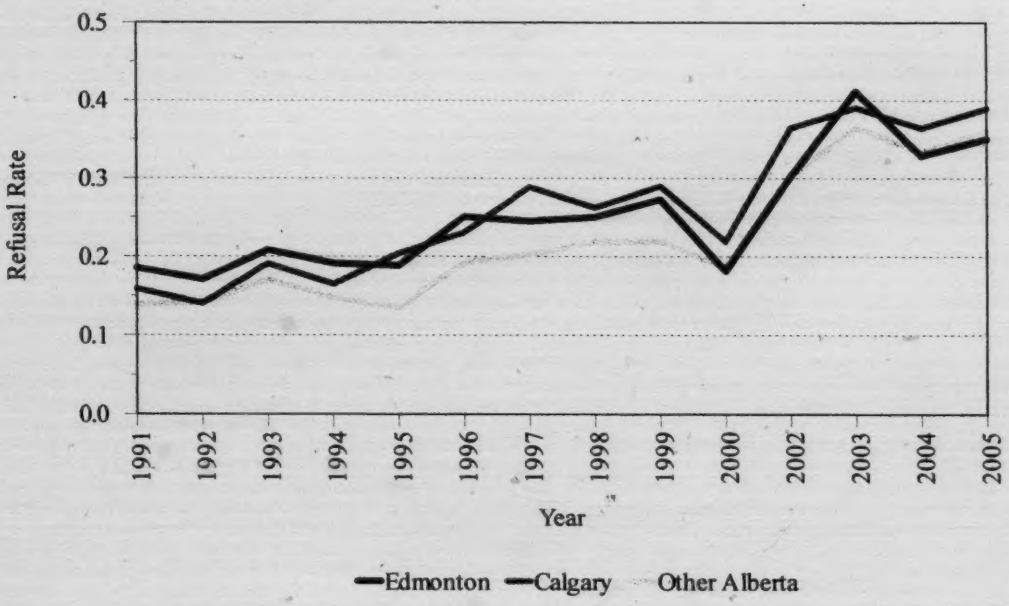
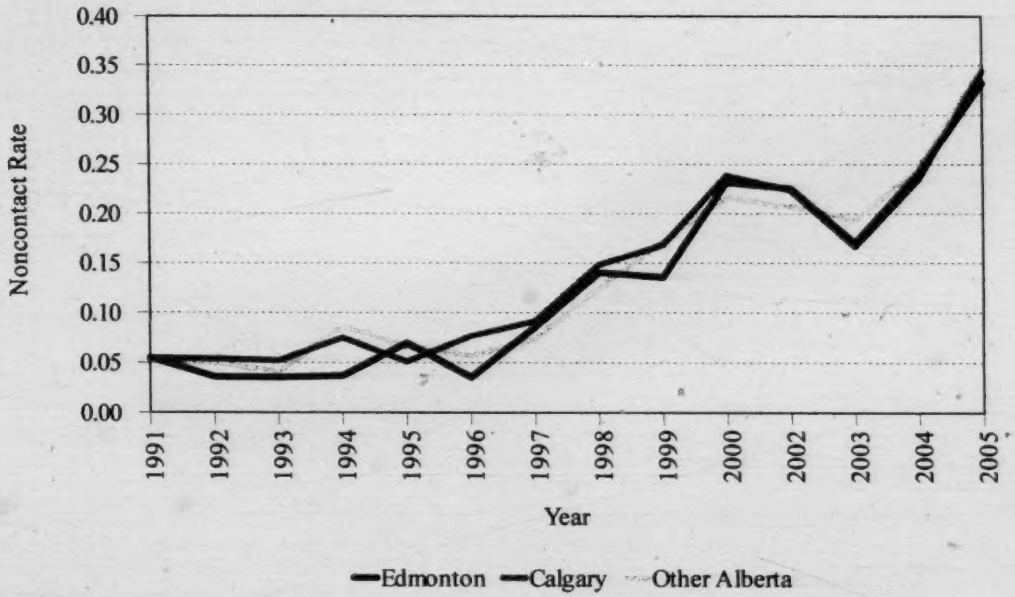


Figure 2.4. Noncontact rates by region: 1991 – 2005

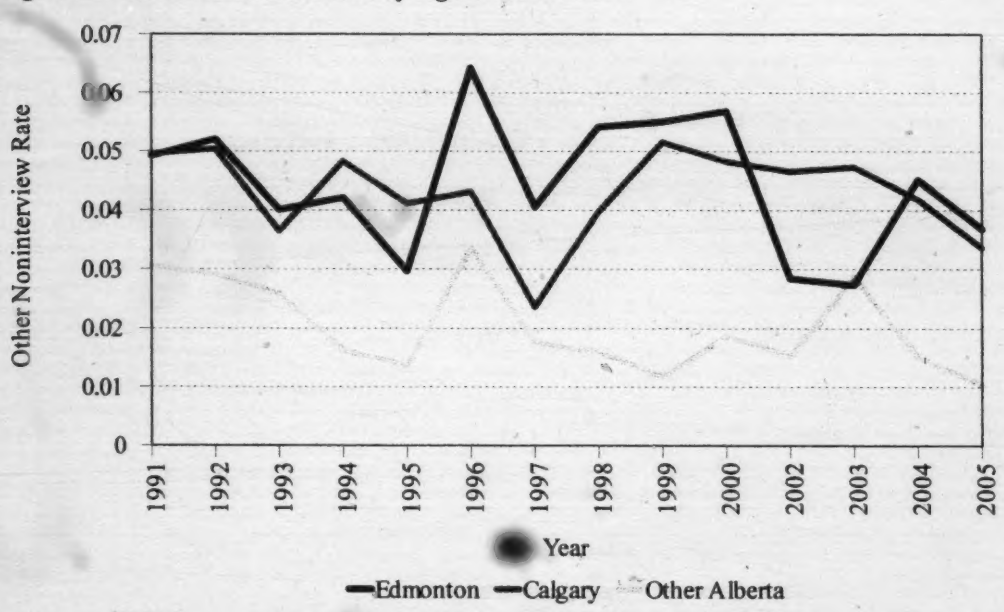


While response rates have been declining, refusal rates and noncontact rates have been on the rise in all three regions. As shown in Figure 2.3, refusal rates have been increasing fairly steadily over time despite several isolated years where a slight drop occurred (e.g., 1994-1995 and 2000). The sharpest increase in refusal rates for all three regions occurred from 2000 to 2003. While the trend for noncontact rates also shows a substantial increase over time, as depicted in Figure 2.4, the trend is of a slightly different form than is the case for refusals. Specifically, while refusal rates show an overall steady increase from 1991 to 2005, noncontact rates remain relatively stable in the period from 1991 to 1996. It is from 1996 onwards when noncontact rates begin the steep ascent which continues to the present, despite a slight drop in 2003.

While none of the three regions consistently display the highest or lowest noncontact rates observed, nonrespondents from Other Alberta tend to have a slightly lower refusal rate than do individuals from either Edmonton or Calgary. Once again, this finding

supports previous research indicating that individuals residing in high-density urban areas are somewhat more likely to refuse survey participation (DeMaio 1980; Fitzgerald and Fuller 1982; Groves and Couper 1998; Smith 1983; Voogt and Van Kempen 2002). Alberta Survey data do not, on the other hand, replicate studies suggesting that metropolitan areas also tend to have higher rates of noncontact than do rural areas (see Groves and Couper 1998; Steeh et al. 2001; Voogt and Van Kempen 2002). However, this should not be interpreted as a contradiction of previous research. The "Other Alberta" category used in the Alberta Survey includes rural communities along with a number of towns and small cities. Thus, the apparent divergence between this and other studies may merely be a result of differences in categorization of urban and rural communities.

Figure 2.5. Other noninterview rates by region: 1991 - 2005



Unlike the trends that are clearly apparent for response rates, refusal rates, and noncontact rates, the other noninterview rate, which includes nonresponse due to

circumstances such as language barriers and physical illness or disability, does not display an overall trend in any of the three regions surveyed. This lack of trend is apparent upon examination of Figure 2.5 which presents a series of seemingly random points that do not vary greatly over time – the noninterview rate does not vary by more than 4% over the time period examined for any of the three regions. Overall, other noninterview accounts for a very small proportion of total nonresponse and does not appear to be subject to systematic changes over time as are refusals and noncontacts.

Changes to Alberta Survey Data Collection Methods

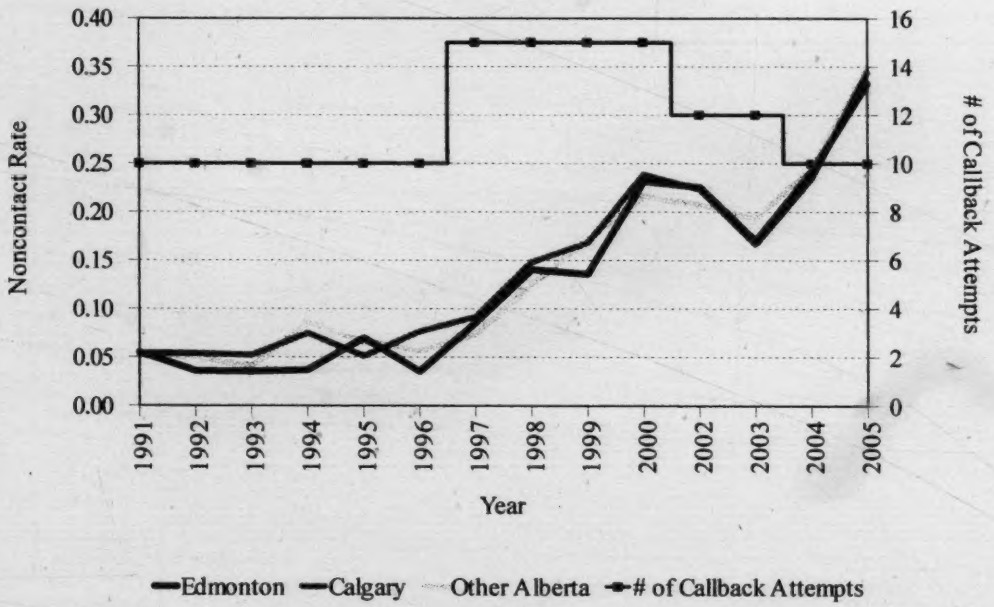
As survey response rates can be sensitive to changes in data collection methods, it is important to take into account any methodological alterations when investigating response rate trends. Changes in the manner in which a survey is conducted over time, or changes in survey design, can influence the proportion of sample units not reached (noncontacts), the proportion declining participation (refusals), as well as the proportion that interviewers are unable to interview for other reasons (other noninterviews) (see de Heer 1999; de Leeuw and de Heer 2002; Dillman et al. 2002; Groves, Cialdini and Couper 1992; Groves and Couper 1998). For example, if the number of callback attempts made before declaring a sample unit as a noncontact is reduced it may result in an increase in the proportion of noncontacts. Similarly, changing the length of the data collection period may affect ability to contact, and gain participation from, potential respondents.

Hence, methods used in administration of the Alberta Survey from 1991 to 2005 were examined, as outlined in each year's *Alberta Survey Sampling Report* (see Population

Research Lab 1991-2005). Some changes did occur that could potentially impact response rates, each of which is explored here.

First, the number of callback attempts varied from ten to fifteen over the time period examined, beginning at ten in 1991, increasing to fifteen in 1997, subsequently being reduced to twelve in 2002, and finally back to ten in 2004. As the number of callback attempts was not consistently decreased from 1991 onward it is difficult to attribute declining response rates to changes in this survey element.

Figure 2.6. Number of callback attempts and noncontact rate



Moreover, one would expect that changing the number of callbacks would have the greatest impact on noncontact rates as individuals would have either more or less opportunity to be contacted, depending on the direction of the change (i.e., whether number of callbacks were increased or decreased). However, Figure 2.6 demonstrates that, overall, noncontact rates do not reflect changes in the number of callbacks. The

only exception may be in the period from 2003 to 2005 where the number of callbacks was reduced from twelve to ten and the noncontact rate showed a relatively steep increase. However, in general, Alberta Survey response rate trends appear to be largely unaffected by the changes in the number of callback attempts.

A second change to survey methods involved some variation in the time of year at which the Alberta Survey was administered. For the majority of years the survey was conducted over various one or two month periods between February and May, but from 1997 to 2002 the time of administration shifted to between October and February. However, the decline in response rates is steady over the entire time period and the only year where even a slight increase was observed was 1992. As such, it seems unlikely that the declining response rates are attributable to alterations in the time of survey administration.

The length of data collection period can also influence ability to contact, and subsequently gain participation from, potential respondents (Dillman et al. 2002; Groves and Couper 1998). However, the length of administration of the Alberta Survey remained fairly consistent over the time period examined. From 1991 to 1998 data collection occurred over two month periods, and subsequently decreased to a period of approximately one month for 1999, 2000, and 2002. From 2003 on, the data collection period rose to roughly two months once again. Thus, it does not appear that length of data collection period had an effect on response rates.

A third important element of survey design to consider involves variation in the length of the survey. Research suggests that because survey length is associated with respondent burden, it affects potential respondents' willingness to participate (Groves,

Cialdini and Couper 1992; Groves and Couper 1998). Hence, changes to the length of the Alberta Survey could influence response rates. Changes in the average interview time for the Alberta Survey, reported in the Sampling Reports,[12] were reviewed from 1991 to 2005.

Figure 2.7. Response rates and mean interview time

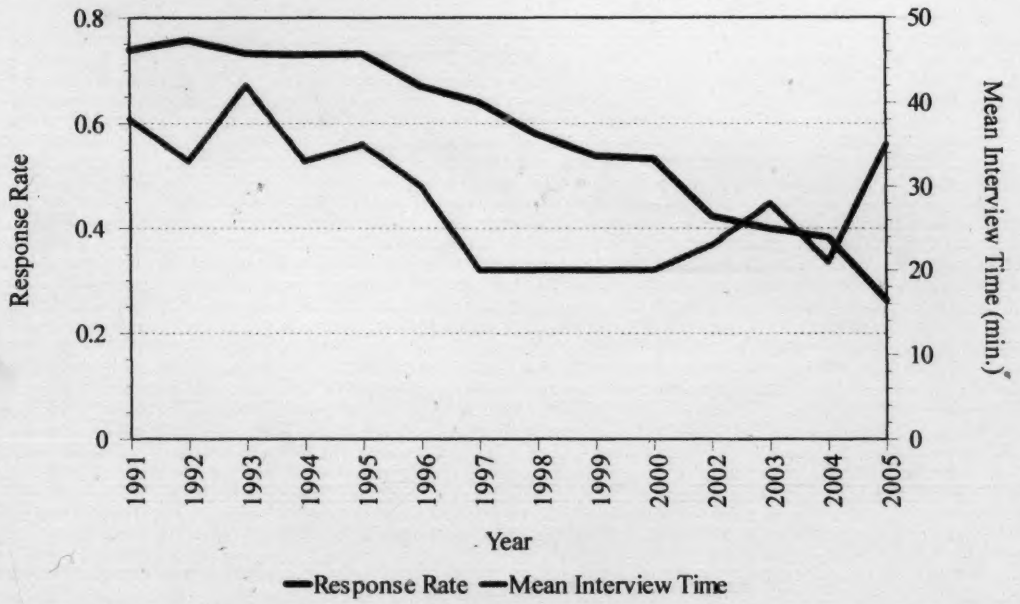


Figure 2.7 presents the trends in both response rates and mean interview time for the Alberta Survey. Mean interview time varied from twenty to forty-two minutes. The graph demonstrates that while decreases in mean interview time did not result in higher response rates, in some cases longer interview times may result in a steeper decrease in response rates. Specifically, 2005 shows a sharp rise in interview time from the previous

[12] Note that mean interview time was reported in three formats in the Alberta Survey Sampling Reports. From 1991 to 1994 the mean interview time for each of the three regions included in the Alberta Survey (Edmonton, Calgary, and Other Alberta) was reported. The average from these three figures was then calculated to obtain the overall mean interview time. From 1995 to 2000 there was no mean time reported per se; rather statements such as "…the respondent for the thirty-five minute interview" (Population Research Lab 1995, 4) provided an indication of interview time for that year. From 2002 to 2005 the overall mean interview time was reported.

year accompanied by a steep decline in response rates. Overall, however, there does not appear to be strong support for the hypothesis that fluctuations in the length of the Alberta Survey account for changes in the rate of decrease of response rates.

A final issue related to data collection that warrants brief discussion involves the random generation of telephone numbers for the survey sample. In January of 1999 the area code for the northern half of the province was changed from '403' to '780', while the southern half retained the original '403' exchange (Kowal 1998). This switch resulted in many more "not in service" numbers associated with each exchange, as the number of possible telephone numbers within Alberta doubled (Dave Odynak, personal communication, August 23, 2006). However the Population Research Lab recorded "not in service" numbers and deducted these from the final eligible sample used when calculating response and nonresponse rates, as reported in the *Sampling Reports*. Consequently, the data reported in this study should not be affected by changes to the telephone exchanges used in Alberta.

Thus, while Alberta Survey methods did undergo some changes over the time period examined, they do not seem to account for the consistent reduction in response rates or the rise in refusals and noncontacts observed. If revisions to the process of survey administration are not responsible for the rapidly declining response rates, there must be other causes independent of the survey itself, such as the social trends explored in the introductory chapter.[13] Although there may be a number of social forces influencing

[13] Research also suggests that quality of interviewers can play a significant role in willingness of potential respondents to cooperate with survey requests (de Leeuw and de Heer 2002; Groves, Cialdini and Couper 1992; Groves and Couper 1998; Keeter et al. 2000; Steeh et al. 2001). However, the time period under

Footnote continued on the next page.

response rate trends, this does not necessarily mean that response and nonresponse trends are similar across all surveys. As such, I will now briefly compare trends in Alberta Survey response and nonresponse rates with those from two other surveys.

Are Alberta Survey Response Rate Trends an Isolated Phenomenon? Comparison with Other Telephone Surveys

Results from the literature review, discussed previously in this chapter, clearly indicated that many researchers are reporting declining response rates in telephone surveys as a growing problem. However, in order to better understand how response rate trends in the Alberta Survey compare to those occurring elsewhere, a direct comparison was made between Alberta Survey response and nonresponse rates and those from two other surveys: The Survey of Consumer Attitudes conducted by the University of Michigan, and the General Social Survey conducted by Statistics Canada.

The Survey of Consumer Attitudes was chosen for comparison because: a) it is administered by a research unit within a major university and thus bears some similarity to the Alberta Survey; b) it is conducted within the United States, allowing for direct comparison of Canadian and American response rate trends; and c) there is published information available on its response and nonresponse rates (see Curtin, Presser and Singer 2000; Curtin, Presser and Singer 2005). The General Social Survey (GSS) was selected for comparison primarily because it is administered by a federal government department within Canada, thereby permitting exploration of the hypothesis that government surveys tend to achieve higher response rates than those conducted by other

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analysis in this study spans a decade and a half. It is highly improbable that the quality of individual interviewers declined steadily over this time.

organizations. Comparison with the GSS also allows us to ask whether Alberta Survey trends are widespread and can be generalized, at least to an extent, to all surveys in Canada, or whether there are elements of the Alberta Survey which render it unique from other Canadian surveys.

Comparison of university-administered surveys: The Alberta Survey versus the Survey of Consumer Attitudes

The Survey of Consumer Attitudes (SCA) is a national survey of households within the United States administered monthly by the University of Michigan. Since 1980 the SCA has been conducted as a random-digit-dialed telephone survey (Curtin, Presser and Singer 2000). Curtin, Presser and Singer (2005, 90) suggest that response rates to the SCA "have been marked by three distinct periods: a gradual decline from 1979 to 1989; a plateau from 1989 to 1996 (when there was essentially no change), followed by an even sharper decline after 1996". Referring back to Figure 2.1, it is evident that for the time period where data are available for both the SCA and the Alberta Survey, a similar pattern is apparent in both. Most notably, in the period prior to the mid-nineties response rates to both surveys are relatively stable and from the mid-nineties on, response rates begin a steep decline that continues to the present. Although response rates to both surveys follow roughly the same pattern, the decline from 1991 to 2003[14] is nonetheless greater in the Alberta Survey, which witnessed a decline from 74% to 40%, than it is in the SCA where response rates fell from slightly over 60% to 48% (Curtin, Presser and Singer 2005).

[14] Although response rate data for the Alberta Survey is available up to 2005, the information on the SCA presented in Curtin, Presser and Singer (2005) only includes data until 2003. Thus, comparison of decline in response rates is only possible for the period from 1991 to 2003.

Both surveys have also experienced a rise in refusals, although the increase in refusal rates is greater in the Alberta Survey (from 16% in 1991 to 37% in 2005) than in the SCA (from 19% in 1979 to 27% in 2003) (Curtin, Presser and Singer 2005). However, in both surveys, the increase in refusal rates has been more pronounced in later years.

While response and refusal rates tend to follow a similar pattern across the Alberta Survey and the SCA, the same is not true for noncontact rates. Curtin, Presser and Singer (2005) report that noncontact rates for the SCA increased dramatically following 1985, but that the rate of increase slowed after 1996. The Alberta Survey, on the other hand, shows a very different trend where noncontacts did not begin a steep ascent *until* the mid- to late-nineties, and from that period onward there has been a steady rise (see Figure 2.1). It is unclear why this difference in noncontact trends exists. One can speculate that it may be related to changes in data collection methods of the SCA, such as more callback attempts, but this kind of information is not currently available in the literature.

Although the trends in noncontact rates are of different forms, the trends in response rates and refusal rates across the Alberta Survey and Survey of Consumer Attitudes bear remarkable similarity, even if they are more pronounced in the Alberta Survey. These findings suggest that a pattern of rapidly declining response rates following the mid-nineties, accompanied by an increase in refusal rates which is more pronounced in later years, is not unique to the Alberta Survey. Rather, the pattern may be typical for RDD household telephone surveys administered by university-based organizations. Thus, response and refusal trends apparent in Alberta Survey data may be indicative of widespread trends occurring within household RDD telephone surveys administered by similar organizations.

Comparison of university- and government-administered surveys: The Alberta Survey versus the General Social Survey

The General Social Survey (GSS), established in 1985, is a random-digit-dialed telephone survey administered by Statistics Canada.[15] It is administered over a period of one year and targets individuals over the age of fifteen residing in private households in Canadian provinces. The GSS is intended to collect data on social trends as well as on "specific social policy issues of current or emerging interest" (Statistics Canada 2006b).

Figure 2.8. Alberta Survey and GSS response and refusal rates:[16] 1991 – 2005

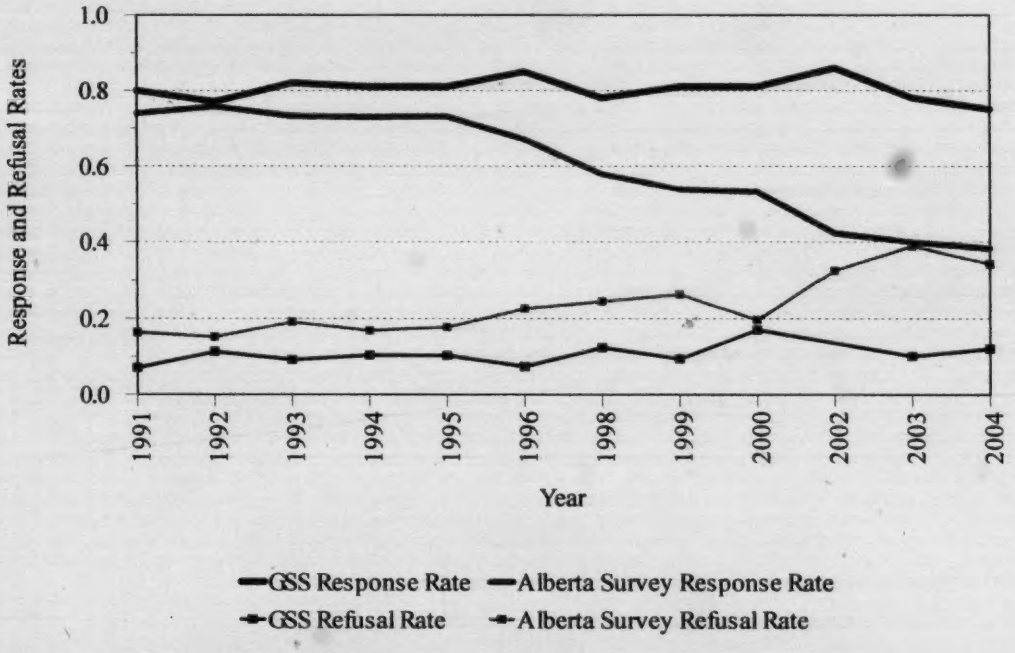

Figure 2.8 presents the response and refusal rates to both the Alberta Survey and the GSS,[17] and clearly illustrates that there are marked differences between the two surveys.

[15] Random digit dialing was not used in Cycle 16 of the GSS, conducted in 2002 (Statistics Canada 2006b).
[16] The refusal rate for the GSS was separated into "household refusals" and "respondent refusals" (Statistics Canada 2006b). Thus, for the purposes of this research, household and respondent refusal rates were combined to yield the single refusal rate reported in these analyses.

Over the same time period that Alberta Survey response rates have decreased by 48%, GSS response rates have remained relatively stable around 80%, falling only slightly to 75% in 2004. While refusal rates for the GSS have shown an increase from 7% in 1991 to 12% in 2004, this increase is substantially smaller than the 21% rise experienced by the Alberta Survey. No data were available on noncontact rates for the GSS.

Higher response rates to government surveys are likely the result, at least in part, of the perceived legitimacy of the sponsoring organization. That is, surveys sponsored and/or administered by the government are more likely to be viewed as "legitimate" surveys by a wider segment of the population than are those conducted by either academic or private organizations. Perceived status, or prestige, of the sponsoring organization also likely plays a role in decisions of survey participation. While it is quite probable that universities are accorded more status than government by many, the government is nonetheless widely recognized within society as a legitimate organization. Moreover, the status accorded to university-affiliated organizations may be dependent on potential respondents' own experiences with post-secondary institutions. Thus, individuals who have attended post-secondary institutions may view universities as higher status organizations than do those with no post-secondary experience. Finally, as the government frequently solicits various forms of information from citizens (for example, information pertaining to income taxes, the census, and health care), it is possible that Canadians are accustomed to government requests for information and thus more likely to comply with survey requests. Hence, there are a number of factors that

[17] The GSS was not administered in 1997, so all data for that year are excluded from Figure 2.8 and related analyses.

operate in favour of government organizations which may positively influence survey participation for a wide segment of the population.

Discussion

These analyses plainly demonstrate that response and refusal trends apparent in the Alberta Survey do not extend to all Canadian surveys. Rather, Alberta Survey trends appear to be more representative of surveys conducted by a particular kind of organization (university-affiliated) than of surveys conducted within a particular geographic area (i.e., Canada). It is important to note that while response rates to surveys administered by university-affiliated organizations are much lower than those administered by government, response rates to surveys administered by private sector organizations are experiencing even greater difficulties. For example, drawing on information from the Council for Marketing and Opinion Research (CMOR), Steeh et al. (2001, 228) state that response rates to RDD commercial telephone surveys average around 12%. Note that this article was published five years ago, and it is likely that average response rates have declined even further since that time. Thus, the Alberta Survey is certainly not unique in its experiences of falling response rates and rising refusal rates, but neither are its experiences generalizable to all RDD household telephone surveys.

While there may be differences in response rate trends for surveys administered by different types of organizations, the literature review and Alberta Survey analyses presented in this chapter have demonstrated that the problem of declining response rates is very real for many surveys. Rising refusal rates and a more recent increase in

noncontacts appear to be the primary culprits for this trend, and thus both are of great concern to survey researchers. Moreover, the decline in response rates is, overall, steeper in later years, thereby rendering any significant rise in response rates improbable in the near future and corroborating the concerns of researchers who fear that the challenges posed by nonresponse will not subside in the years to come (see de Leeuw and de Heer 2002; Groves et al. 2002).

That both refusal and noncontact rates are increasing, but following slightly different patterns, provides further insight into the possible reasons for the decline in response rates, as outlined in the introductory chapter. The fairly steady rise in refusals lends support to the notion that householders are becoming increasingly frustrated – and thus impatient – with survey requests, possibly due to over-surveying and inundation with unsolicited phone calls such as those received from telemarketers. It also offers support for householder frustration stemming from "SUGGING" (selling under the guise of research) and/or "FRUGGING" (fundraising under the guise if research) (see de Leeuw and Hox 2004; Groves and Couper 1998; Remington 1992; Schleifer 1986).

The more recent sharp ascent of noncontact rates suggests that the impact of technology on survey response rates may be growing. Specifically, it is quite possible that call screening devices such as caller ID are being used more widely to screen out calls from unknown numbers, such as those that would appear from survey organizations. When the adoption of such technologies is considered in conjunction with householder frustration resulting from over-surveying, telemarketing, SUGGING, and FRUGGING, the potential effect becomes even more pronounced. That is, the possibility that the

recent rise in noncontacts is at least partially due to householders actively choosing not to answer calls that may be from survey organizations is increasingly likely.

Concerns related to privacy and/or confidentiality could potentially factor into both the refusal and noncontact trends. Specifically, it is likely that those concerned with privacy- and confidentiality-related issues will not only refuse participation in surveys, but also that such individuals are more likely to employ call screening devices like caller ID and, thus, to become noncontacts (see Haggerty and Gazso 2005a). If privacy- and confidentiality-related concerns are indeed growing in the population, a peripheral effect of this growth could be a rise both refusal and noncontact rates.

It is important to note that actively refusing to participate in a survey or deciding not to answer phone calls originating from particular numbers, regardless of the underlying reasons, reinforces the premise that all potential survey respondents are individuals with agency, as the theoretical framework outlined in Chapter 1 purports. That is, potential respondents are not simply there to be tapped for information if survey methodologists can find a way to do so, but rather they engage actively in the response process. Moreover, the nature of potential respondents' engagement is reflective of both their individual position within society and their individual attitudes, but it is also reflective of the larger social forces that are acting at a societal level. For example, if public debates around privacy are prominent in society during a given period of time, survey response rates may be negatively affected. de Heer (1999, 139) suggests that such a situation occurred in The Netherlands and Sweden in the 1980s. Similarly, as discussed in Chapter 1, over-surveying can have a negative impact on the survey climate.

Thus, studying the nature of call disposition trends does more than just provide survey methodologists with information on how sample individuals are responding (or not) to survey requests. Rather, the nature of such trends is, at least to an extent, reflective of larger social forces present in societies within which surveys are conducted. As Tourangeau (2004, 776) states: "Perhaps no other research tool used by social scientists is as sensitive to social and technological change as the sample survey. Surveys are themselves part of the fabric of contemporary life".

This chapter has clearly demonstrated the nature of response and nonresponse trends that are occurring in the Alberta Survey, and has also made clear that rapidly declining response rates are causing researchers much concern. However, *why* declining response rates provide such cause for concern has yet to be fully addressed. Hence, in Chapters 3 and 4 I turn to the critical question of how falling response rates affect the quality of survey data through first reviewing the relevant literature (Chapter 3) and, subsequently, examining the consequences of such a decline in the Alberta Survey (Chapter 4).

Chapter 3. Literature Review: Understanding and Measuring Nonresponse Bias

The analyses and discussion presented in Chapter 2 clearly demonstrated that response rates to household telephone surveys, and to the Alberta Survey in particular, have been rapidly declining. Moreover, this decline is of substantial concern to many survey researchers. However, it is not the response rate itself that provides cause for concern, but rather the implications of low response rates, namely the possibility of less valid data. This chapter reviews the literature relevant to the second research question: *How do nonresponse rates in household telephone surveys affect nonresponse bias?*

Nonresponse Bias: What it is and when it matters

Nonresponse bias can be understood as the difference between estimates of population characteristics and the population's true characteristics arising as a result of systematic differences between respondents and nonrespondents (see Berg 2005; Fowler 2002). In other words, nonresponse bias reduces the *representativeness* of survey data.

There is often a close relationship between response rates and nonresponse bias. Specifically, the threat of nonresponse bias occurring in survey research increases as nonresponse rates grow (Bethlehem 2002; Novo, Hammarstrõm and Janlert 1999; O'Neil 1979; Voogt and Van Kempen 2002). However, it is important to note that high nonresponse rates do not automatically imply nonresponse error or bias (Curtin, Presser and Singer 2000; Keeter et al. 2000; Groves et al. 2002; Merkle and Edelman 2002; Weisberg 2005). Rather, it is only when respondents and nonrespondents differ on key

variables of interest that bias becomes problematic (Bethlehem 2002; Groves and Couper 1998; Haggerty and Gazso 2005a; Steeh 1981; Voogt and Van Kempen 2002).

It is also possible for some survey variables to be affected by nonresponse bias while others within the same survey remain unaffected (see Ellis, Endo and Armer 1970; Lynn and Clarke 2002; Smith 1983). For example, survey items related to privacy or surveillance issues may become biased as individuals with privacy or surveillance concerns might be less inclined to participate in a survey (see Haggerty and Gazso 2005a). However, other items within the same survey may be unrelated to, and therefore unaffected by, such concerns. Similarly, bias may not affect background variables such as age or income but may be found in certain behavioural or attitudinal items, or vice versa (see Voogt and Van Kempen 2002). Thus, it is important to reiterate that nonresponse bias is only problematic when it is connected to survey variables of interest. How one can actually locate bias is a more complicated matter that is discussed in both this chapter and the next.

Respondent Characteristics as Correlates of Nonresponse

The survey research literature does provide some guidance regarding which background variables are most likely to be related to nonresponse and therefore, potentially, nonresponse bias. Specifically the variables gender, age, education, socioeconomic status, household size and composition, urbanicity, and population density are variables often discussed as possible correlates of nonresponse. The relevant literature pertaining to each of these variables is reviewed in this section.

Gender. Gender is a factor often cited as a correlate of nonresponse. According to Groves and Couper (1998, 136), research tends to suggest that there is either no difference in likelihood of cooperation between males and females, or that females are somewhat more likely to cooperate. However, gender may be associated with other factors such as respondent contactability and reluctance, potentially resulting in either noncontact or refusal, respectively (see Groves and Couper 1998; Smith 1983). This may lead to an underrepresentation of men in surveys, as Weisberg (2005, 173) suggests is often the case. Goyder (1987, 85) states that "sex…seems to be among the most ambiguous of socio-demographic correlates of response," thereby indicating that there is not a straightforward relationship between gender and likelihood of survey participation.

Age. Age is another variable often reported as a correlate of nonresponse, although which age groups are least likely to respond is somewhat unclear. For example, a number of articles suggest that elderly persons are more likely to refuse participation (see, for example, Cannell et al. 1987 in Groves and Lyberg 1988; DeMaio 1980; Fitzgerald and Fuller 1982; Goyder 1987; Groves and Lyberg 1988; Nathan 2001; O'Neil 1979; Smith 1983; Weisberg 2005). Conversely, based on a review of previous studies, Novo, Hammarstrõm and Janlert (1999) report that younger persons are more likely to become nonrespondents – a conclusion that is corroborated elsewhere (Lynn and Clarke 2002; Rispens and Van Goor 2000). Neither of these findings is fully supported by the work of Groves and Couper (1998, 150) who suggest that younger and older households tend to have higher cooperation rates (once contacted) than do middle-age households.

There are two possible explanations for these discrepant findings. The first is that age may be related to *type* of nonresponse. For example, it is possible that elderly individuals

are more likely to become refusers, or other noninterviews due to health reasons, while younger people are more likely to become noncontacts (see Goyder 1987; Groves and Couper 1998; Lynn and Clarke 2002; Lynn et al. 2002; Voogt and Van Kempen 2002). Weisberg (2005, 172) emphasizes the difference between refusal and noncontact and the relative role played by these two types of nonresponse among individuals of different age groups. He states (172):

> Young people are more willing to participate if they are successfully contacted, but they are less likely to be at home, which results in underrepresentation of young people in some surveys....The pattern reverses for older persons: they are less likely to cooperate but are more likely to be at home, which typically balances out to overrepresentation of older persons in surveys.

A second explanation emerges from the work of Groves and Couper (1998), who find that when controlling for household size, older persons had a higher rate of cooperation. They suggest that individuals living alone are consistently more difficult to both contact and to gain cooperation from once contacted. Thus, it is possible that factors correlated with age are influencing the participation of elderly and/or young persons in surveys.

Education. Education has been found to be related to nonresponse, but a brief review of the literature also yields somewhat mixed results as to which education groups are least, or most, likely to participate in surveys. For example, in a review of the literature, Groves and Couper (1998) find that those with less education are less likely to respond to surveys. However, in their own study (1998, 128) they report that individuals in lower education groups had a "somewhat higher" rate of cooperation. The reason for these mixed results is unclear, although it is possible that the impact of the sponsoring

organization may be different for individuals with differing levels of education.[18] Overall, though, there is more literature supporting the finding that individuals with lower levels of education are less likely to respond to surveys than the reverse (see, for example, Cannell et al. 1987 in Groves and Lyberg 1988; Ellis, Endo and Armer 1970; Groves 1989; Nathan 2001; Novo, Hammarstrõm and Janlert 1999).

Socioeconomic status. Related to education is socioeconomic status (SES), a variable also cited as a correlate of nonresponse. Once again, the evidence is mixed as to which SES groups display higher likelihood of response to surveys (see Groves and Couper 1998, 126-127). The matter is made more complicated by the variety of indicators used to measure SES, such as income, education, occupation, and housing costs/property value (see, for example, Goyder 1987; Goyder, Lock and McNair 1992; Groves and Couper 1998; O'Neil 1979). The use of these various indicators is not consistent across studies, thereby rendering it difficult to gain a true understanding of the nature of the influence of SES on response rates. Some studies suggest that while individuals of higher SES tend to be more difficult to contact (Curtin, Presser and Singer 2000; Link and Oldendick 1999), once contacted such individuals may be more likely to cooperate (Goyder 1987; Keeter et al. 2000; O'Neil 1979). Other studies show higher cooperation among low SES groups (see, for example, DeMaio 1980; see also Groves and Couper 1998, 127), and still others suggest a "middle class bias" (Goyder 1985; Goyder, Lock and McNair 1992; O'Neil 1979; Rispens and Van Goor 2000; Van Goor and Rispens 2004). Interestingly, Goyder,

[18] The data included in the study conducted by Groves and Couper (1998) originated from surveys sponsored by the federal government. Thus, their findings regarding education offer some support for one hypothesis they explore (1998, 128) which suggests that individuals of lower socioeconomic status may feel more indebted to government as a result of receiving some form of public assistance.

Lock and McNair (1992) suggest that SES is one of the strongest sociodemographic correlates of nonresponse, with high SES consistently predictive of high response.

Household size/composition. Household size and composition are both found to be related to survey participation. Most studies point to lower likelihood of response for individuals in small and, in particular, single-person households (see Groves and Couper 1998; Lynn and Clarke 2002; Rispens and Van Goor 2000; Tourangeau 2004; Van Goor and Rispens 2004) and a higher likelihood for households with children (see Groves and Couper 1998; Smith 1983). Once again, such results could be related to type of nonresponse as there is less likely to be someone at home to be contacted in a single-person household than there is in a household with children. In addition, single-person households are more likely to be inhabited by elderly persons (Groves and Couper 1998), a population subgroup for which we have already seen evidence suggesting lower propensity to respond.

Urbanicity/population density. Finally, it is often suggested that urbanicity and/or population density is related to likelihood of response to surveys. Overall, individuals living in the highest density urban areas, such as the city centres of large metropolitan areas, or large urban centres are the least likely to respond to surveys while those living in rural areas are the most likely to respond (see DeMaio 1980; Fitzgerald and Fuller 1982; Goyder, Lock and McNair 1992; Groves and Couper 1998; Smith 1983; Steeh 1981; Voogt and Van Kempen 2002). Groves and Couper (1998, 168) suggest that population density "may be more proximal correlate [*sic*] of cooperation than urbanicity". Referring to previous research, they posit that living in close proximity to a greater number of strangers and the experience of overstimulation that often accompanies such

conditions can lead to a higher degree of distrust among urban residents and, ultimately, less helpful behaviour (see Groves and Couper 1998, 176-177). In the survey context, "less helpful behaviour" translates into unwillingness to participate and, thus, greater likelihood of refusal.

By reviewing literature related to respondent characteristics and nonresponse it becomes clear that the roles of various correlates of nonresponse are unclear. It is difficult to find consistent support for a higher likelihood of response among any population subgroup. It also becomes evident that investigations into demographic correlates of nonresponse can become quickly muddied if a distinction is not made between type of nonresponse, particularly between refusals and noncontacts (see Goyder 1987; Groves and Couper 1998; Lynn and Clarke 2002; Lynn et al. 2002; Smith 1983; Van Goor and Rispens 2004; Voogt and Van Kempen 2002). As Smith (1983, 395) asserts, "the profile of each type of nonrespondent is quite different".

In addition, the review of the literature revealed that background variables are not independent of one another, but rather are characterized by interacting relationships which render it difficult to focus on one without considering the others (see, for example, Goyder 1987; Groves and Couper 1998; Weisberg 2005). For example, the relationship between age and household size necessitates consideration of the latter when examining the role of the former. Thus, while the intent of this section was to provide an overview of background variables that are often considered correlates of survey nonresponse, the review did not yield a clear picture of a 'typical' nonrespondent or of the resultant 'typical' biases in surveys. Rather it emphasizes the importance of distinguishing between type of nonresponse, as well as the existence of interrelationships between

sociodemographic variables which should be considered when studying the survey response process.

Measuring Nonresponse Bias

Nonresponse bias is comprised of two elements: direction and magnitude (Ellis, Endo and Armer 1970). Direction refers to the manner in which results are biased, while magnitude refers to the degree to which results are biased. Drawing on an earlier example, survey results may be biased toward individuals with fewer concerns related to privacy or surveillance, thereby indicating the *direction* of the bias. In addition, the results may be very biased – for example, if no one with any privacy-related concerns responded – or only somewhat biased, thus reflecting the *magnitude* of the bias present in the results.

The measurement of bias (both direction and magnitude) involves determining the extent to which respondents and nonrespondents differ on some key variable(s) of interest. This task can be particularly challenging for random-digit-dialed (RDD) household telephone surveys, as there is generally little to no information available about nonrespondents. While response rates may serve as an indicator of the *risk* of nonresponse bias (Ezzati-Rice et al. 2000; Groves, Presser and Dipko 2004), response rates themselves cannot directly assess the degree of bias present in survey estimates (Groves et al. 2002; Keeter et al. 2000; Merkle and Edelman 2002). However, researchers interested in the phenomena of nonresponse and bias have developed several methods to deal with this measurement challenge, the most common of which are briefly discussed in this section.

One of the most frequently used methods of measuring nonresponse bias is to treat respondents who were either a) difficult to reach (measured by number of callbacks required), or b) required a refusal conversion (i.e., they initially refused the survey request but were eventually persuaded to participate) as proxies for nonrespondents (see Curtin, Presser and Singer 2000; Ellis, Endo and Armer 1970; Goyder 1987; Lynn and Clarke 2002; Lynn et al. 2002; Novo, Hammarstrõm and Janlert 1999; O'Neil 1979; Smith 1983; Voogt and Van Kempen 2002). This method assumes that those who were difficult to contact are similar to those never contacted and that those who initially refused to complete the survey are similar to those who ultimately refused participation. The difficult to reach are then compared with the easy to reach and the reluctant respondents (i.e., those that required refusal conversion) are compared with the willing respondents.

There are, however, problems associated with the proxy method, the chief of which is a concern with the true distinctiveness of nonrespondents. That is, the question remains whether those who were never contacted or those who ultimately refused to participate in a survey are in some way distinct from those who were eventually contacted or eventually persuaded to participate. Several studies have found that the cases which are hard to complete, due to difficulty contacting respondents or respondent reluctance, are not good proxies for nonrespondents (Ellis, Endo and Armer 1970; Fitzgerald and Fuller 1982; Lin and Schaeffer 1995; Teitler, Reichman and Sprachman 2003). However, regardless of criticisms surrounding this approach to measuring bias, it is nonetheless "used quite regularly for lack of a better method" (Voogt and Van Kempen 2002, 326).

A second method of measuring nonresponse bias involves obtaining information directly on nonrespondents, or on a subsample of nonrespondents, and subsequently comparing variable distributions for nonrespondents with those of survey respondents. There are several approaches through which such information on nonrespondents has been obtained. One is record matching, a procedure that involves using an identifier for the nonrespondent (such as a name, address, or telephone number) to match to information available from other sources, such as national statistical agencies or organizational databases (see Goyder, Lock and McNair 1992; Keeter et al. 2000; Novo, Hammarstrõm and Janlert 1999; O'Neil 1979; Van Goor and Rispens 2004). In a similar approach, information on nonrespondents is available through the source from which the sample was selected and thus nonrespondents and respondents can be compared for the variables included in the original data source (see, for example, Lin and Schaeffer 1995; Teitler, Reichman and Sprachman 2003). The difficulty with these procedures is that there either must be a) some identifier available for nonrespondents that can be matched to records from another information source, or b) information already available on all potential respondents – conditions that are rarely met by samples generated through random digit dialing.

Another approach to obtaining nonrespondent information directly involves re-contacting nonrespondents and requesting that they provide the interviewer with information on specific demographic and/or attitudinal variables (Smith 1983; Voogt and Van Kempen 2002). There are obvious difficulties associated with such a procedure, including high costs due to the fact that a second wave of the survey must be conducted and that response is being solicited from a population of nonresponders. That is, the

method relies on the participation of individuals who previously either could not be contacted or refused to participate in the survey. Thus, measuring nonresponse bias via obtaining information directly on nonrespondents is a method used less frequently than the proxy approach discussed above, likely due to the associated costs and often limited feasibility for certain sampling designs such as random digit dialing.

The third and final method for measuring nonresponse bias that I will discuss here involves the use of auxiliary information.[19] In this method, the distributions of survey variables are compared with the distributions of those same variables at the level of the population (Ellis, Endo and Armer 1970; Goyder 1985; Goyder 1987; Smith 1983; Weisberg 2005). For example, a researcher may compare the age and education distributions of survey respondents with those of the larger population from which the sample was drawn. Population-level data are often available through national statistics agencies, such as Statistics Canada (Bethlehem 2002; Dillman et al. 2002).

A primary problem associated with this method is that it only enables comparison for variables for which there is population-level data available – a requirement that often limits comparison to sociodemographic variables. However, the degree of bias present in background variables is not necessarily reflective of the degree of bias present in other variables of interest, thereby indicating one limitation of this method (Ellis, Endo and Armer 1970; Smith 1983; Voogt and Van Kempen 2002). A second limitation rests with the fact that in such a comparison "one is not checking how much difference comes from nonresponse but how much comes from nonresponse *and* all others sources (item

[19] Auxiliary information refers to "a set of variables that not only have been measured in the survey, but for which information on the sample or population distribution is also available" (Bethlehem 2002, 277).

unreliability, interviewer error, etc.)" (Smith 1983, 387-388). That is, it is difficult to isolate differences between survey and population data arising as a result of nonresponse bias and differences resulting from other sources of error.

However, it is this latter method that will form the basis for the measurement of nonresponse bias in the current study. It is the most appropriate method to use in the following analyses for three reasons: First, it does not suffer from the problematic assumptions inherent in the proxy approach as late or reluctant respondents are not assumed to be representative of final nonrespondents. Second, there is neither the time nor the financial resources available to obtain information on nonrespondents to the Alberta Survey in a more direct manner. Finally, the limitations of this method are fairly easily addressed, as is discussed in Chapter 4. Chapter 4 also presents the operationalization of this approach, including the specific methods used and the results of the associated analyses.

Chapter 4. Implications of Nonresponse in Household Telephone Surveys: Investigating Nonresponse Bias

The review of the literature on nonresponse bias and its measurement in Chapter 3 provided the groundwork for an empirical investigation of the implications of nonresponse bias in household telephone surveys. This chapter analyzes Alberta Survey data to address the second research question: *How do nonresponse rates in household telephone surveys affect nonresponse bias?*

Investigating Nonresponse Bias: Overview of analyses

To investigate the impact of nonresponse rates on nonresponse bias in the Alberta Survey, a four-part process was employed. First, the distributions of five demographic variables from the Alberta Survey were compared with the distributions of the same variables in Canadian census data. Next, the index of dissimilarity for each of the five demographic variables was calculated. Third, the relationships between background variables and various attitudinal and behavioural items were examined using ordinary least squares (OLS) regression. Finally, the implications of the previous analyses were explored through poststratification. That is, weighting factors were developed for three demographic variables and the distributions for a number of behavioural and attitudinal items were then compared before and after the weighting factors were applied. All statistical analyses were conducted using SPSS-X. Each step in this process is discussed in more detail throughout the chapter.

Index of Dissimilarity Analyses: Investigating changes in the magnitude and direction of nonresponse bias present in Alberta Survey data

Methods

Step 1: Comparison of Alberta Survey Data with Canadian Census Data

The first step in investigating the relationship between nonresponse rates and nonresponse bias involved comparing the distributions of five demographic variables from the Alberta Survey with the distributions of those same variables from Canadian census data. Comparisons were drawn for the years 1991, 1996, and 2002 to correspond with Canadian census years.[20] Comparisons were made using census data for individuals over eighteen years of age residing in the province of Alberta to ensure that the sampling frames for the two data sets corresponded as closely as possible.

The five demographic variables analyzed were age, total years of schooling, highest level of education, marital status, and individual income. These variables were selected as, other than marital status, they correspond with the correlates of nonresponse identified earlier in this chapter. Marital status was included as it is another variable occasionally discussed as a correlate of nonresponse (see Bethlehem 2002; Fitzgerald and Fuller 1982; Goyder 1987; Smith 1983), and it seemed plausible that it may be related to response propensity. It was not possible to include either gender or urbanicity in the analyses as sampling quotas are implemented for both of these variables in the Alberta Survey.[21]

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[20] The Canadian census is conducted every five years, meaning that it was conducted in 1991, 1996, and 2001. However, the Population Research Lab did not administer the Alberta Survey in 2001 and, therefore, Canadian census data from 2001 were compared with Alberta Survey data from 2002.

[21] Including variables designated as quota variables in these analyses would be of no value because when a quota is implemented, the distribution of that variable is predetermined. For example, in the Alberta Survey there is a quota implemented for gender to ensure that fifty percent of respondents will be female and fifty percent will be male. Thus, comparing the distribution of females and males obtained in the

Footnote continued on the next page.

While not included in the comparative step of the analyses, household size was controlled for in the regression portion (step three).

As mentioned earlier, there are two key limitations associated with comparing survey and population data. The first is that the degree of bias present in background variables does not necessarily correspond with the degree of bias present in other variables of interest (Ellis, Endo and Armer 1970; Smith 1983; Voogt and Van Kempen 2002). To address this limitation, the relationships between the sociodemographic variables analyzed and eighteen attitudinal and behavioural items were explored using ordinary least squares (OLS) regression (discussed in more detail later in the chapter). The assumption behind this approach is that if there is bias present in the background variables, it likely affects other items with which the background variables are significantly related (see Bethlehem 2002; Voogt and Van Kempen 2002). Thus, determining where relationships exist will enable a broader understanding of which survey variables are likely affected by bias. However, a limitation still remains in the current study as the approach does not enable identification of bias in items not significantly related to the five background variables analyzed.

The second limitation of this method lies in its inability to distinguish differences between survey and population data due to nonresponse bias and those resulting from other sources of error, such as measurement and interviewer error (Smith 1983). The seriousness of this limitation is lessened in the current study by comparing the distributions of variables over a number of years rather than focusing on a single point in

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Alberta Survey with the actual distribution in the population, as indicated in census data, would not provide any insight into nonresponse bias arising from the differential likelihoods of response for males and females.

time. The wording of the questions providing data for the five demographic variables under analysis remained consistent across the years analyzed, as did the key components of the data collection methods used. Thus, other sources of measurement error, such as those due to question wording, should remain fairly similar across the three years examined. While it is not possible to know exactly how much of the differences between distributions are due to nonresponse bias alone, it is reasonable to assume that changes over time are likely attributable to changes in response rate, as question wording and other data collection methods remained consistent.

Step 2: Calculation of the Index of Dissimilarity

An advantage of employing this method where the variable distributions for survey respondents are compared with those of the larger population is that it enables use of the *index of dissimilarity* to measure nonresponse bias. The index of dissimilarity (ID) is a tool "commonly used, especially in the social sciences and with large datasets, to describe the lack of fit of models with categorical data" (Kuha and Firth 2005, 2). The ID, popularized by Duncan and Duncan (1955), is most commonly used in research related to residential, geographic, and occupational segregation. It has also been used as a measure of the difference between two age distributions (Hobbs 2004, 157), a use that is replicated in this study and extended to the other four background variables analyzed. The Population Research Lab at the University of Alberta has used the index of dissimilarity to provide an indication of the representativeness of Alberta Survey data along the dimensions age and marital status (see Population Research Lab 1991-2005).

The index of dissimilarity is relatively simple to compute. It is calculated as one half the sum of the absolute differences in the percentages between groups, denoted by the formula (McKibben and Faust 2004, 118):

$$ID = \frac{1}{2}\sum_{i=1}^{N}|x_i - y_i|$$

The ID, when calculated as a difference in proportions, ranges from zero to one with smaller values representing better model fit and larger values representing poorer model fit (Agresti 2002). It can be interpreted as the proportion of cases in one group that would have to be moved to other cells to make the distributions of X and Y identical (Agresti 2002). For example, if the age distributions of two groups, X and Y, are being compared and the ID is equal to 7%, then 7% of the cases in group X would have to be relocated to other age categories in order to make the distributions of X and Y equivalent. The greater the proportion of cases that must be relocated, the less alike the two models are. Therefore, in this study, smaller values of the ID are more desirable as they indicate more representative data (i.e., a higher degree of similarity between population and survey data).

Its relative simplicity of calculation and interpretation render the index of dissimilarity an attractive tool for evaluating model fit (see Jacobs 1993). When survey data are compared with population data, calculating the ID for several different variables provides a measure of how closely the survey data fit with the population data along those dimensions. In other words, such an analysis provides a measure of how representative the survey data are of the population from which the sample was drawn.

If calculation of the ID for several variables is repeated for a number of years, the ID can then be used as an indication of how the representativeness of a particular survey has changed over time, at least for the dimensions under analysis. It is in this capacity that the ID is used when comparing Alberta Survey data with population-level data obtained from the Canadian census. The index of dissimilarity is calculated for age, marital status, highest level of education, total years of schooling, and individual income for the years 1991, 1996, and 2002. In addition, the ID is calculated for the variable age for the year 2005, comparing Alberta Survey data with postcensal estimates[22] (obtained from Statistics Canada 2006a). ID scores were calculated for all of Alberta as well as for Edmonton only and Calgary only. ID scores were not calculated separately for the Other Alberta region due to the difficulty of matching census and Alberta Survey regions outside of the two primary metropolitan areas.

In order to calculate the index of dissimilarity, each variable was recoded to achieve consistent categories for the variables across the two data sets.[23] However, as calculation of the index of dissimilarity is based on differences between categories, it would appear that the number of categories the variable is recoded into could impact results of the ID calculations (Siegel 2002). Continuous quantitative variables, such as total years of schooling and age, might be particularly susceptible to this potential problem as there is a broad range of coding schemes available (see Siegel 2002).

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[22] Postcensal population estimates for 2005 were only available for a very limited number of variables. Hence, age is the only dimension among the five analyzed for which there is adequate population-level data available to calculate the index of dissimilarity score for 2005.

[23] For the variable "marital status," respondents to the Alberta Survey indicating that they were either married or in a common-law relationship were included under the "married" category, as there was no common-law response option available in the census.

To investigate this concern in the context of the current study a mini-experiment was conducted. The experiment involved systematically altering the number of categories for the variables "total years of schooling" and "individual income" from the 2002 Alberta Survey and subsequently calculating the index of dissimilarity for each variation. The number of categories used for total years of schooling was increased from four to seven, and for income the number of categories was decreased from ten to five. The results of the experiment showed that the impact on the index of dissimilarity scores was negligible (refer to Appendix B for a more detailed presentation of results). Thus, it is reasonable to conclude that if different coding schemes were employed for the variables in this study, the impact on the index of dissimilarity results would be minimal.

It is unclear at exactly what value of the index of dissimilarity one can no longer say that two models are similar, or, in other words, at what point two distributions become dissimilar. While one source indicates that any index under .10 (10%) represents model similarity (Population Research Lab 1998, 13), another states that when the ID is less than .02 or .03 the two models fit quite closely (Agresti 2002). However, in the present study it is not an *absolute* cut-off point that is of greatest importance. Rather, it is the *relative degree of change over time* in the value of the index of dissimilarity that is of most interest and most relevance.

Results: Index of dissimilarity analyses

Results of the index of dissimilarity analyses for the complete province of Alberta are summarized in Figure 4.1. These results pertain to the *magnitude* of nonresponse bias

present in the five sociodemographic variables analyzed, and how it changes over time. The specific calculations for each variable are located in Appendix C.

Figure 4.1. Index of dissimilarity scores: All Alberta

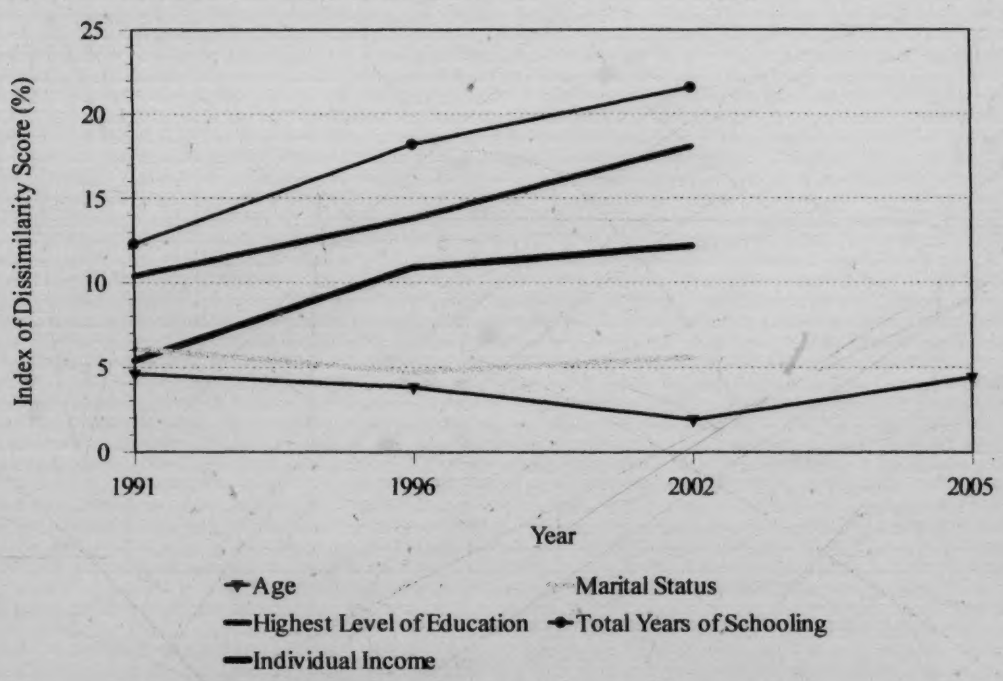


Figure 4.1 reveals that the index of dissimilarity scores for the two education variables – "highest level of education" and "total years of schooling" – are consistently higher than the indices for the other variables examined and increase quite steadily from 1991 to 2002. The index of dissimilarity for highest level of education reaches 18.1% by 2002, and for total years of schooling it reaches 21.6%, the highest value among all the variables examined. The variable "individual income" also shows an increase in index of dissimilarity scores, reaching a maximum score of 12.2%. The ID scores for "age" and "marital status" tend to be the lowest among the five variables analyzed and neither shows an overall upward or downward trend over the time period examined. I will now

turn to a more detailed discussion of the trends in index of dissimilarity scores for each of these variables, including an examination of regional differences in the trends. Following the regional analyses, the *direction* of bias will be investigated for each variable.

Highest Level of Education

Figure 4.2. Index of dissimilarity scores for "highest level of education" by region

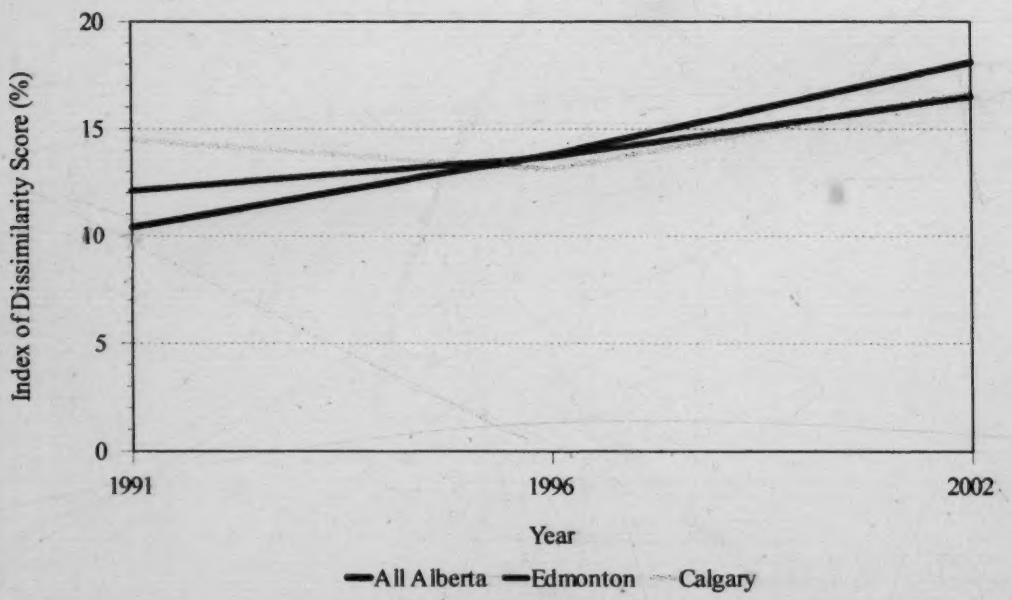


Figure 4.2 presents trends in index of dissimilarity scores, by region, for the variable "highest level of education". At 18.2% for All Alberta in 2002, the ID for highest level of education reaches the second highest score among the five variables examined. Both All Alberta and Edmonton show a steady increase in ID scores, while Calgary experiences a slight drop from 1991 to 1996. However, this decrease is minimal at less than 2%. The baseline scores for all three regions are over 10% in 1991 and the largest increase is experienced by All Alberta, rising from 10.4% in 1991 to 18.2% by 2002 – a total increase of 7.7%. The overall steady rise in index of dissimilarity scores for highest

level of education indicates that Alberta Survey data are becoming, over time, less representative of the actual level of education held by Albertans.

Total Years of Schooling

Figure 4.3. Index of dissimilarity scores for "total years of schooling" by region

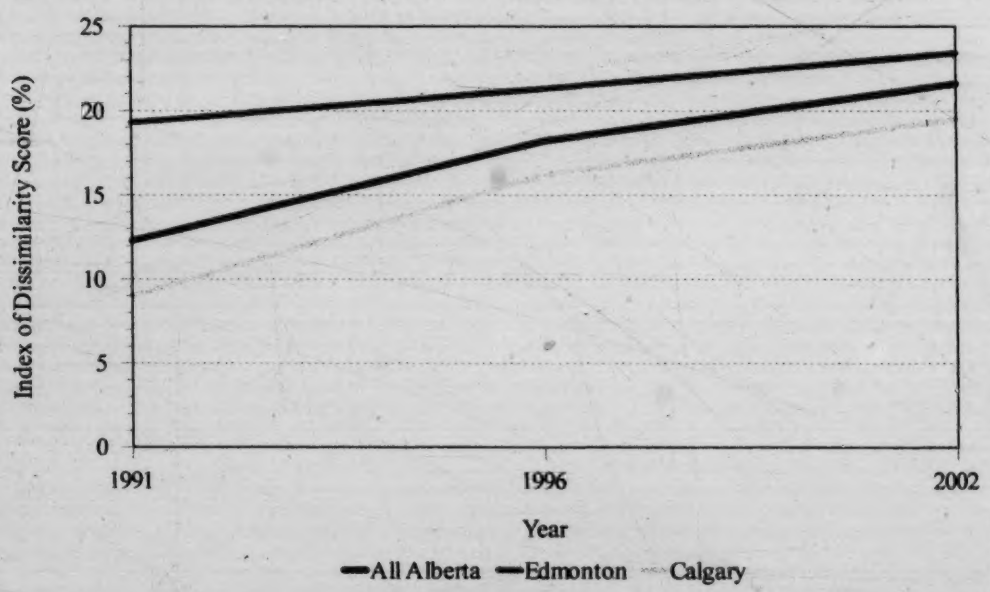
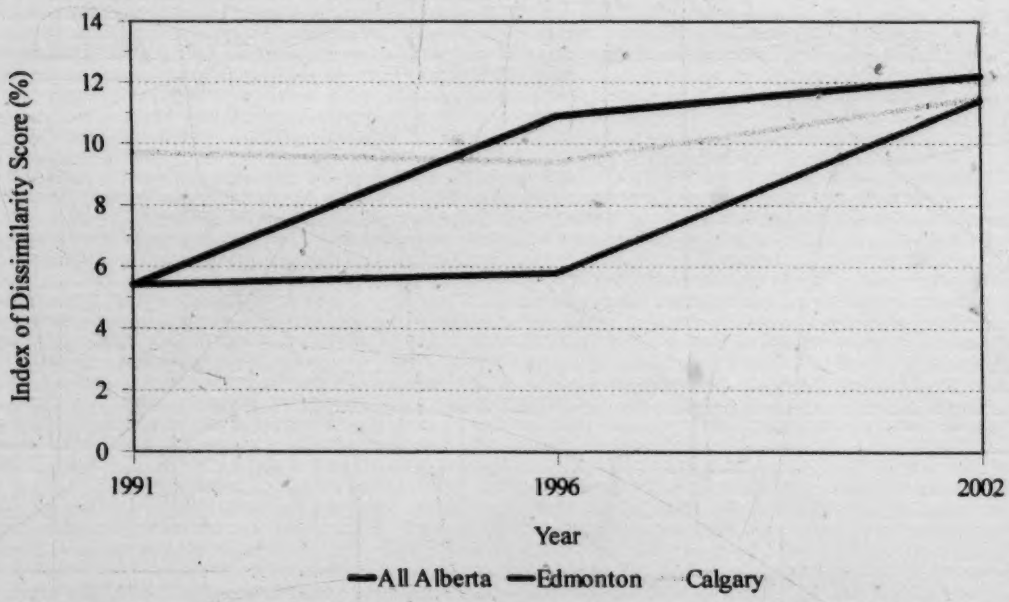


Figure 4.3 reveals trends in index of dissimilarity scores for the variable "total years of schooling" that are quite alarming. In 1991 the baseline scores for total years of schooling are already high in all three regions. Calgary experiences a substantial increase of 10.5%, followed closely by All Alberta with a 9.3% increase. Interestingly, while the rise in ID scores for Edmonton is somewhat smaller at only 4.1%, this region nonetheless shows the highest scores for all three years examined, reaching 23.4% by 2002 – the highest ID value for any variable examined across all three regions. Such high baseline scores, combined with the upward trends displayed in Figure 4.3, render the index of

dissimilarity scores substantial by 2002 and indicate increasing unrepresentativeness of Alberta Survey data for this variable.

Individual Income

Figure 4.4. Index of dissimilarity scores for "individual income" by region

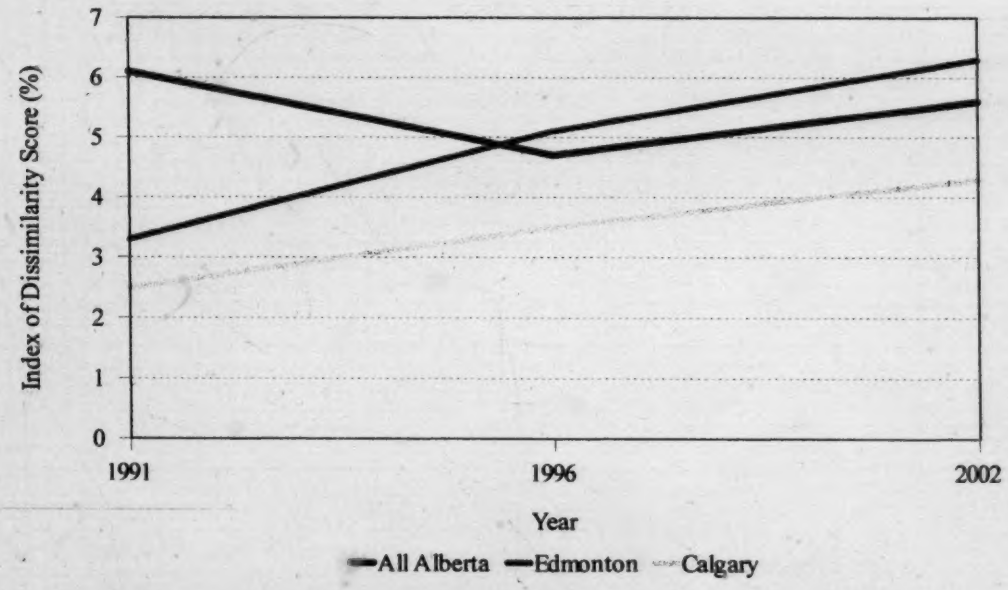


While index of dissimilarity scores for the variable "individual income" are lower than those for either of the education variables, the scores do reveal an overall increase from 1991 to 2002 for all three geographic areas examined (Figure 4.4). The largest increase was experienced by All Alberta, beginning at 5.4% in 1991 and increasing by 6.8% over the eleven year period, reaching a maximum score of 12.2%. Edmonton also showed a fairly substantial increase of 6.0% in ID scores, while Calgary only experienced a 1.8% overall increase. Although scores for the Edmonton region rose at a greater rate than did those for Calgary, the actual ID scores for Calgary are higher each year than they are for Edmonton in terms of individual income. However, the scores for the two areas

do converge by 2002. Like the education variables, the trends in index of dissimilarity scores for individual income indicate that Alberta Survey data are becoming increasingly unrepresentative of the actual Alberta population for this variable.

Marital Status

Figure 4.5. Index of dissimilarity scores for "marital status" by region

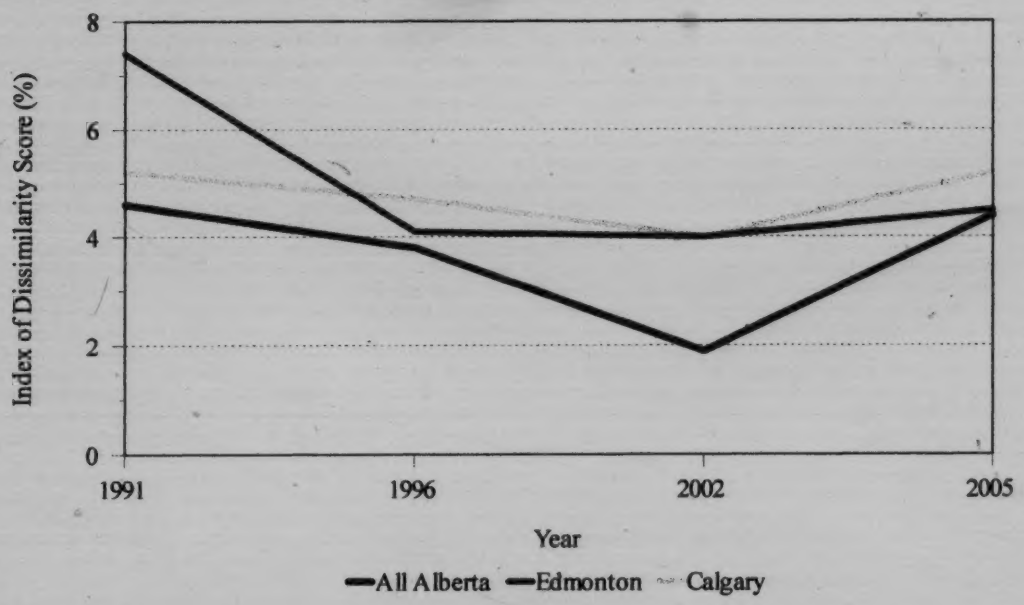


Figures 4.1 and 4.5 demonstrate that, unlike the previous variables examined, the overall trends in index of dissimilarity scores for "marital status" are unclear and do not indicate an overall upward or downward pattern in the period from 1991 to 2002. The ID score is highest for All Alberta in 1991 at 6.1%, and by 2002 the highest score is 6.3% for the Edmonton region. While All Alberta experiences a slight decrease in ID scores from 1991 to 2002, both Edmonton and Calgary show slight increases over the same time period (3.0% and 1.8% respectively). However, the index of dissimilarity remains under 6.5% for all regions over the entire time period, and is thus substantially smaller than the

indices for the education and income variables. While these analyses suggest that there is less bias present in marital status than in the previous variables examined, it is difficult to draw firm conclusions regarding the direction of trends in ID scores. It is worth noting, however, that each region does display a slight increase in ID scores from 1996 to 2002 and, therefore, it will be important to monitor the trends for this variable in the future.

Age

Figure 4.6. Index of dissimilarity scores for "age" by region



Similar to marital status, the index of dissimilarity scores for "age" do not display clear upward or downward trends for any of the three regions analyzed. Figure 4.6 indicates that the ID scores for age are less than 8% in each region across the entire time period, which extends from 1991 to 2005 for this variable. Index of dissimilarity scores actually decreased from 1991 to 2002, but then increased somewhat from 2002 to 2005 in all three geographic areas. The increase is particularly noticeable for All Alberta and the

Calgary region, where index of dissimilarity scores rose back to their 1991 levels. Given these findings, age is a dimension that should be monitored closely in the future to determine if the upward trend in ID scores will continue beyond 2005.

The analyses that have been presented thus far have demonstrated that the degree of nonresponse bias is greatest for the variable "total years of schooling", followed by "highest level of education" and "individual income". Moreover, these variables are becoming increasingly affected by bias over time. The bias is substantially less in the variables "age" and "marital status", and whether there is a trend toward increasing bias in these two variables remains unclear. It is now time to turn to an examination of the *direction* of bias present in these variables, and the first three in particular.

Direction of Nonresponse Bias

The variables "highest level of education", "total years of schooling", and "individual income" all demonstrated high index of dissimilarity scores following an upward trend, thus indicating that they are affected by an increasing level of bias. In order to determine the manner in which bias is impacting Alberta Survey results, it is necessary to determine which categories within each variable are over- and underrepresented in Alberta Survey data. To do so, the proportion of cases in each category for the five variables examined from the Alberta Survey were compared with Canadian census data for Alberta, and differences between the distributions were calculated according to the formula:

Difference = (Alberta Survey proportion) – (Canadian census proportion)

Thus, a negative value indicates that the category is underrepresented in Alberta Survey data, and a positive value that the category is overrepresented in the Alberta Survey. The results are presented in Table 4.1.

Table 4.1 reveals some clear and interesting trends related to education and income. Overall, individuals with the lowest levels of education are becoming increasingly underrepresented in the Alberta Survey while individuals with higher levels of education are increasingly overrepresented. These results suggest that, over time, Alberta Survey data have become progressively less representative of the actual level of education of the Alberta population and progressively more biased towards individuals with more schooling.

While the differences between individual categories are much smaller than is the case for the two education variables, a similar trend emerges when individual income is examined. Specifically, Table 4.1 demonstrates that those with the lowest income are underrepresented in Alberta Survey data while those with average and high levels of income are overrepresented. Given the findings for the two variables related to education, the trend apparent for individual income is not surprising as, in general, those with more education also tend to have a higher income.[24] As a result, it seems that Alberta Survey data are becoming more biased towards those with a higher income as well as towards those with a higher level of education.

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[24] In the 2002 Alberta Survey there was a moderate positive correlation between income and highest level of education ($r = 0.25$, $p < .01$) and a moderate positive correlation between income and total years of schooling ($r = 0.24$, $p < .01$). My own analysis of Canadian census data (for Albertans age eighteen or over) yielded similar results for the correlation between highest level of education and income ($r = 0.27$, $p < .01$), and the same results for the correlation between income and total years of schooling ($r = 0.24$, $p < .01$).

Table 4.1. Differences* between the distribution of variables in the Alberta Survey and Canadian census for all Alberta

	1991	1996	2002	2005
Highest Level of Education				
Less than high school	-9.9%	-13.8%	-14.7%	-
High school graduate	7.0%	7.9%	8.6%	-
Some non-university	-0.6%	0.6%	-3.4%	-
Some university	3.4%	5.4%	9.5%	-
Total Years of Schooling				
Less than 9 years	-2.8%	-3.8%	-4.6%	-
9-12 years	-9.5%	-14.4%	-17.0%	-
13-17 years	11.3%	14.0%	16.3%	-
18 or more years	1.0%	4.3%	5.3%	-
Individual Income				
< $16,000	-5.3%	-10.9%	-9.3%	-
$16,000 - 25,999	0.1%	0.0%	-3.0%	-
$26,000 - 35,999	1.7%	3.2%	0.6%	-
$36,000 - 45,999	0.4%	2.4%	1.9%	-
$46,000 - 54,999	0.9%	0.6%	3.5%	-
$55,000 - 64,999	0.7%	0.3%	1.6%	-
$65,000 - 74,999	0.5%	0.9%	1.5%	-
$75,000 - 84,999	0.4%	0.8%	0.3%	-
$85,000 - 99,999	0.0%	0.9%	0.6%	-
$100,000+	0.7%	1.6%	2.1%	-
Age				
18-24	-1.4%	-2.4%	0.1%	-2.0%
25-34	4.3%	-0.2%	1.8%	-1.7%
35-44	0.2%	2.1%	0.0%	1.0%
45-54	-1.2%	-0.5%	-0.3%	1.7%
55-64	-1.7%	0.8%	-0.0%	1.3%
65-74	-0.2%	0.9%	-0.2%	0.4%
75+	-0.2%	-0.8%	-1.4%	-0.7%
Marital Status				
Single (never married)	-5.8%	-4.8%	-4.7%	-
Married†	5.0%	2.1%	5.7%	-
Separated	0.6%	0.5%	-0.1%	-
Divorced	-.04%	0.4%	-0.7%	-
Widowed	0.6%	1.6%	-0.2%	-

* Differences were calculated as: (Alberta Survey proportion) – (Canadian census proportion).
† The "married" category combines respondents from the Alberta Survey indicating that they were either married or common-law.

The differences between Alberta Survey and census data in the various categories for age and marital status tend to be smaller than those associated with the education and

income variables, as would be expected from the results of the index of dissimilarity calculations. The differences in age categories do not show any clear trend over the time period investigated. The differences within the marital status categories, however, do demonstrate that married individuals are consistently the most overrepresented in Alberta Survey data while those who are single (i.e., never married) are consistently the most underrepresented. Thus, there does seem to be a slight bias toward individuals who are currently married (or common-law), and a consistent underrepresentation of those who were never married. However, this trend does not appear to be becoming more pronounced over time and the bias is of a much lower magnitude than is the case for education and income.

Regression Analyses: Relationships of sociodemographic variables and measures of behaviour and attitude

Due to the nature of the method used in this research project (comparison of population-level data with Alberta Survey data), direct comparison between survey and population data is only possible for variables that are measured in both data sets. Thus, the index of dissimilarity was only calculated for a limited selection of sociodemographic variables. However, it has already been emphasized that nonresponse bias is only problematic when it is connected to key variables of interest, and key variables of interest are more likely to be those that measure respondent attitudes or behaviours than they are to be variables such as age or income. It is therefore necessary to somehow gauge the degree of bias that may be present in attitudinal and behaviour items based on the findings related to the sociodemographic variables already examined.

Methods

In order to extend the index of dissimilarity analyses to survey items representing a broader range of topics, ordinary least squares (OLS) regression was employed to regress a variety of attitudinal and behavioural items on sociodemographic variables. These regressions were conducted to explore the relationships between sociodemographic variables and respondent attitudes and behaviours while controlling for other potentially related variables. As Bethlehem (2002, 287) states: "if there are sufficiently strong relationships between auxiliary variables and target variables,...conclusions with respect to a possible bias carry over to the target variables". This conclusion is echoed by Voogt and Van Kempen (2002, 326) who emphasize that differences between respondents and nonrespondents on background variables only translate into differences between these two groups on variables of interest "when there is a relationship between the variables of interest and the background variables" (see also Weisberg 2005, 174).

A total of eighteen regression analyses were conducted with a wide range of attitude/behaviour items as the dependent variables. The dependent variables included selected items from the Alberta Surveys administered from 2002 to 2005 falling into four broad attitude/behaviour categories: health issues, social issues, environmental issues, and crime- and surveillance-related issues. The items were chosen to represent a wide range of topics that could serve as a key variable of interest in a study. Specifically, questions related to long-term care, education, immigration, same-sex marriages, the environment, surveillance, and neighbourhood crime were included in the analyses. The specific survey items designated as dependent variables are presented in Appendix D.

Eight control variables were used consistently across the regressions: sex, age, total years of schooling, marital status, whether the respondent lived in an urban or rural location, number of people in the household, whether the respondent owned or rented a home, and individual income. These variables were chosen for two primary reasons: first, because they are variables that are often thought to be related to attitudes and behaviours and second, to correspond with the dimensions investigated in the index of dissimilarity analyses. Including all of these variables as control variables also takes into account the interrelationships among sociodemographic variables that were discussed in the section on the correlates of nonresponse in Chapter 3. Through the inclusion of multiple control variables, the effect of one predictor variable can be examined while taking into account the possible effects of other variables with which it may be related.

In order to conduct the regressions, the variables sex, marital status,[25] urban/rural residence,[26] and home ownership were recoded into dummy variables. Age and total years of schooling were left as continuous variables and individual income remained in its original categorical form. The specific items included as control variables are outlined in Appendix D.

Results: Regression analyses

As there were eighteen dependent variables investigated, each of the eight control variables could have a maximum of eighteen significant effects across all of the

[25] Marital status was recoded into a dummy variable with married and common law = 1 and single, separated, divorced, or widowed combined in the reference category.

[26] For the purposes of these analyses "urban" was defined as city only, while towns and villages were included in the "rural" category. It was assumed that both the opportunities available in and the cultures of towns and villages would be more similar to those of rural areas than cities, and thus including them in the "rural" category would increase the validity of the urban/rural binary variable. Urban area, that is, residence in a city, was coded as "1" while rural served as the reference category.

regressions. Total years of schooling had the greatest number of significant effects (ten) followed by sex and age (nine each). The urban/rural variable was associated with five significant effects, household size and income with three, and marital status and home ownership were each associated with only one significant effect across all eighteen regression analyses.

The dependent variables were classified into four categories: health issues, social issues, environmental issues, and crime- and surveillance-related issues. For the three items examined in the health issues category, sex was associated with the most significant effects (two). Among the eight social issues items, total years of schooling had the greatest number of significant effects (six). Age and sex each had two significant effects out of a possible four in the environmental issues category. Finally, age and total years of schooling were each associated with two out of a possible three significant effects in the crime-related issues category. The beta values and levels of significance associated with the four control variables that had five or more significant effects across the regression analyses (i.e., were significantly related to at least 25% of the dependent variables investigated) are presented in Table 4.2. The full table with beta values and significance levels for all eight control variables is presented in Appendix E.

The results from the regression analyses indicate that total years of schooling, sex, and age significantly affect the greatest number of dependent variables across a wide range of topics. Thus, any bias present in these three demographic variables also has the greatest potential to affect data related to the widest range of attitude and behaviour items. When considered in conjunction with results from the index of dissimilarity analyses, particularly those related to total years of schooling, these findings are of great

Table 4.2. Beta values and significance levels for total years of schooling, sex, age, and urban or rural residence

Dependent Variable	*Control Variables*				
	Sex	**Age**	**Years of Schooling**	**Urban/ Rural**	**$R^{2\dagger}$**
Health Issues					
Long-term care regulation	.11**	-.02	-.02	-.09*	.01
Long-term care subsidies	.10**	.03	-.00	-.03	.01
Physical activity	.00	-.15**	.10**	.06	.06
Social Issues					
Funding for public education	-.07*	-.06	.12**	.04	.03
Health of democracy	.06	.05	-.04	.01	.00
Influence of big business	-.02	.03	.12**	-.02	.01
Government hides information	-.06	.09*	.02	-.01	.01
Support for US war on terrorism	.12**	.12**	-.13**	-.07*	.07
Openness to immigrants after Sept. 11, 2001	.04	-.06	.14**	.16**	.05
Welfare recipients	.08*	-.13**	-.20**	-.04	.07
Same-sex marriages	-.16**	-.27**	.17**	.13	.15
Environmental Issues					
Health of environment in Alberta	.10**	.09*	-.03	.02	.01
Influence of environmentalists	.07	.14**	-.17**	-.11**	.08
Protected areas	-.07*	-.06	.03	.05	.01
Risks from drinking tap water	-.05	-.01	-.06	.02	.00
Crime-related Issues					
Support for video surveillance	-.14**	.05	-.07*	-.05	.04
Concern with new surveillance technologies	-.06	.11**	.00	-.03	.01
Neighbourhood crime	-.04	.11**	-.11**	.14**	.03
Total # of significant effects	***9***	***9***	***10***	***5***	

† Adjusted R^2

* $p < .05$; ** $p < .01$

consequence. The index of dissimilarity calculations revealed not only that Alberta Survey data were biased towards those with more schooling, but that data were becoming *less* representative of the actual distribution of Albertans' level of education over time. Results of the regression analyses suggest that the bias present in total years of schooling,

which is already high and experiencing a steady upward climb, has the potential to influence more attitude and behaviour items than is the case for any of the other sociodemographic variables investigated. Thus, it is likely that the ten variables for which total years of schooling is a significant predictor are biased, at least to some degree.

Sex and age were each significant predictors for 50% of the dependent variables analyzed, and each had at least one significant effect in all four attitude/behaviour categories included in the regressions. These results suggest that any bias present in the variables sex and age is likely to affect a wide range of other variables as well, thereby negatively affecting the representativeness of results. While it was impossible to examine the degree of bias in the variable sex based on Alberta Survey data due to the use of a quota sample,[27] some research does suggest that sex, or gender, may be a correlate of nonresponse, thereby opening up space for bias to enter into survey results (see Goyder 1987; Groves and Couper 1998; Smith 1983).

The index of dissimilarity analyses suggested that there was no clear trend for age in terms of representativeness of the Alberta population. However, results did suggest that age may become more biased over time, if the trend observed from 2002 to 2005 continues. Given that age is a significant predictor for a wide range of variables (Table 4.2), there is potential for bias in this variable to have a substantial impact. Therefore, the representativeness of survey data along the dimension age should be closely monitored in future years of the survey.

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[27] The proportion of male and female respondents in the Alberta Survey is controlled through quota sampling. The Alberta Survey requires that 50% of respondents are female and 50% are male.

Whether the respondent resided in an urban or rural area was a significant predictor for 28% of the dependent variables. There was at least one item in each of the four dependent variable categories with which urban or rural residence was significantly related. While, like sex, it was not possible to measure bias in respondent area of residence for Alberta Survey data as a result of the use of quotas for respondent location,[28] other research does suggest that degree of urbanicity is a correlate of nonresponse in surveys (see Fitzgerald and Fuller 1982; Goyder, Lock and McNair 1992; Groves and Couper 1998; Smith 1983; Steeh 1981; Voogt and Van Kempen 2002). Thus, there is potential for nonresponse bias related to area of residence to influence survey items across a variety of topics.

Interpretation of Independent versus Dependent Variables in the Current Study

The purpose of the regression analyses was to determine which control variables displayed significant effects and what types of items those effects were primarily associated with (e.g., health-related items, crime-related items). Thus, while the primary variable of interest in most regression equations is the dependent variable, it is the control variables that are of most interest here. Total years of schooling, sex, age, and urban/rural residence are associated with the greatest number of significant effects across the eighteen dependent variables examined. Since the proportion of males and females as well as the proportion of respondents from urban and rural areas in the Alberta Survey sample are controlled through quota sampling, the remaining analyses focus primarily on the effects of age and total years of schooling. Individual income is also included in the

[28] The proportion of respondents residing in Edmonton, Calgary, and Other Alberta is controlled through quota sampling in the Alberta Survey.

remaining analyses as ID calculations revealed that this variable is associated with relatively high, and steadily increasing, levels of bias.

Poststratification: Examining the 'real' implications of nonresponse bias on survey data

Methods

In the final step of assessing the impact of nonresponse rates on nonresponse bias, data were poststratified along the dimensions age, total years of schooling, and individual income based on Canadian census data. Poststratification can be defined as "the use of stratified sample estimators for unstratified designs" and can be used, for example, "if the distribution of demographic variables in the sample differs from the distribution in the population based on a Census" (Gelman and Carlin 2002, 290-291). In this instance, poststratification simply involved the development of weighting factors for the variables age, total years of schooling, and individual income based on Canadian census data. The weights were then applied to Alberta Survey data and the distributions of five behaviour/attitude items were compared before and after weighting. The degree of difference between the before-and-after distributions provides a clear illustration of the impact of bias on selected dependent variables.

Three items were selected from the 2003 Alberta Survey and the remaining two from the 2005 Alberta Survey. The five items used in this comparative analysis were selected for two reasons. First, items with relatively high beta values associated with age, total years of schooling, and individual income were selected, based on the results of the regression analyses (see Table 4.2). Second, variables were chosen for relevance to

contemporary political and/or health-related issues and debates. The dependent variables used for before-and-after comparisons were:

1. confidence in ability to participate in regular physical activity,
2. level of agreement with whether gays and lesbians should have the right to get married,
3. level of agreement with whether Canada should support the United States in all facets of its war on terrorism,
4. level of agreement with whether Canada should be as open to immigrants/refugees now as it was before September 11 2001, and
5. assessment of the influence of environmentalists in Alberta on government.

Weights for all variables, other than age in the 2005 Alberta Survey, were developed using data from the 2001 national census as this was the most current population information available. Annual postcensal estimates produced by Statistics Canada for 2005 were used to calculate the weighting factors for age for the 2005 Alberta Survey (obtained from Statistics Canada 2006a). Weights used in poststratification were calculated using the following formula (Bethlehem 2002, 277):

$$w_i = \frac{N_h / N}{n_h / n}$$

Where:[29]

- N_h is the number of population elements (individuals) in stratum h (a particular category of the variable)
- N is the total population size
- n_h is the number of available observations (respondents) in stratum h (a particular category of the variable)

[29] The explanation of elements contained in this formula was adopted from Bethlehem 2002, 277.

- n is the total number of available observations (respondents)

Applying the formula to this particular study, it can be understood more easily as the following:

$$\text{Weighting Factor} = \frac{\text{Proportion of Total Population}}{\text{Proportion of Alberta Survey Respondents}}$$

Weighting factors were calculated for each response category within the variables of interest. Separate weights were developed for the 2003 and 2005 Alberta Surveys. The calculated weights ranged in value from 0.40 to 4.11. The specific calculations and weighting factors used are presented in Appendix F. It is important to note that the weighting factors may slightly under- or overestimate the true difference between Alberta Survey and population data as they were calculated for age and total years of schooling categories rather than for each integer. Thus, some of the variability may have been lost through categorization.

Distributions were compared by calculating the difference in the *proportion* of respondents falling under each response category for a particular variable before and after weights were applied. Summing the differences across all response categories provided the "total difference" between proportions. The greater the total difference, the more bias there was in the data before weighting. For example, if the total difference was equal to eight, then eight percent of respondents moved to another response category following application of the weighting factors.

Weighting factors were calculated for the city of Edmonton only rather than for Alberta as a whole, the reason being that there is already a weight which must be applied to Alberta Survey data when doing calculations for the entire province. The provincial

weight is necessary as the proportion of respondents from various regions of Alberta are determined by quota and, therefore, do not correspond to the actual population distribution within the province. SPSS does not permit the simultaneous application of multiple weighting factors, and so it was necessary to apply the newly developed weighting factors to only one of the three quota areas included in the Alberta Survey (Edmonton, Calgary, and Other Alberta). The city of Edmonton was chosen as it is the capital of the province.

Results: Poststratification

Referring back to the regression analyses, one would expect that if bias is present in a control variable which has a large effect on a given dependent variable, then the distribution of the dependent variable would change if the bias was removed. For example, for the dependent variable "support for same-sex marriages" (should gays and lesbians have the right to get married), total years of schooling had a large significant effect ($\beta = .17$, $p < .01$). However, the index of dissimilarity previously calculated for total years of schooling demonstrated that individuals with less schooling are underrepresented in Alberta Survey data. Thus, we would expect that if those with fewer years of school were *not* underrepresented, the distribution of the variable "support for same-sex marriages" would be different. Through poststratification it is possible to examine exactly how adjusting survey estimates to minimize bias resulting from various sociodemographic variables affects the distribution of survey items related to the background variables. Results of poststratification for the five variables included in the analysis are presented in Tables 4.3 through 4.7.

Table 4.3. Impact of poststratification on item "Confidence in ability to participate in regular physical activity" (Alberta Survey 2005)

Response Category	Proportion of Sample (%)						
	Before Weight Applied	After Age Weighting	Difference (Age)	After Years of School Weighting	Difference (Schooling)	After Income Weighting	Difference (Income)
Not at all	5.8	5.7	0.1	7.7	1.9	5.6	0.2
Slightly	6.0	6.1	0.1	6.7	0.7	6.7	0.7
Somewhat	19.3	19.4	0.1	20.5	1.2	19.7	0.4
Quite	23.9	24.1	0.2	21.7	2.2	24.2	0.3
Completely	45.0	44.7	0.3	43.4	1.6	43.8	1.2
Total Difference			***0.8***		***7.6***		***2.8***

For the 2005 Alberta Survey item "confidence in ability to participate in physical activity," application of weighting factors for total years of schooling had the largest impact (total difference of 7.6%) while weighting for age had the smallest impact (0.8%) (see Table 4.3). Weighting for individual income produced a total difference of 2.8%. The total difference after weighting for total years of schooling was the second largest difference observed across all variables. However, there does not seem to be a pattern for this item as to which response categories were most affected by bias.

Table 4.4. Impact of poststratification on item "Gays and lesbians should have the right to get married" (Alberta Survey 2005)

Response Category	Proportion of Sample (%)						
	Before Weight Applied	After Age Weighting	Difference (Age)	After Years of School Weighting	Difference (Schooling)	After Income Weighting	Difference (Income)
Strongly disagree	40.9	40.8	0.1	49.2	8.3	40.7	0.2
Disagree	7.4	7.5	0.1	6.9	0.5	7.1	0.3
Neutral	11.2	11.4	0.2	9.2	2.0	11.3	0.1
Agree	11.9	12.0	0.1	11.9	0.0	11.8	0.1
Strongly agree	28.7	28.3	0.4	22.8	5.9	29.1	0.4
Total Difference			***0.9***		***16.7***		***1.1***

Of the five items examined, the 2005 Alberta Survey question asking respondents if gays and lesbians should have the right to get married was most affected by bias. Table

4.4 indicates that it displayed the largest total difference in proportions (16.7%) after weighting for total years of schooling. The response categories on the two extremes ("strongly disagree" and "strongly agree") were most affected by bias. The proportion of individuals with opinions in the middle three categories changed a maximum of 2.0%, while the proportions of individuals responding "strongly disagree" or "strongly agree" changed 8.3% and 5.9%, respectively. Table 4.4 suggests that prior to poststratification for years of schooling, the data were affected by a liberal bias; that is, a greater proportion of respondents were supportive of same-sex marriages. The effects of applying weighting factors for individual income (1.1% total difference) and age (0.9% total difference) were minimal.

Table 4.5. Impact of poststratification on item "Canada should support the United States in all facets of its war on terrorism" (Alberta Survey 2003)

Response Category	Proportion of Sample (%)						
	Before Weight Applied	After Age Weighting	Difference (Age)	After Years of School Weighting	Difference (Schooling)	After Income Weighting	Difference (Income)
Strongly disagree	31.7	32.1	0.4	29.8	1.9	32.9	1.2
2	20.6	20.4	0.2	19.0	1.6	22.0	1.4
3	16.6	16.5	0.1	16.3	0.3	16.3	0.3
4	15.3	15.3	0.0	17.1	1.8	14.5	0.8
Strongly agree	15.8	15.6	0.2	17.8	2.0	14.3	1.5
Total Difference			***0.9***		***7.6***		***5.2***

The item in the 2003 Alberta Survey asking respondents whether "Canada should support the United States in all facets of its war on terrorism" reflected the second highest level of bias.[30] Once again, as shown in Table 4.5, the greatest total difference before and after weighting factors were applied was observed for total years of schooling, with a

[30] After weighting for total years of schooling, respondent's confidence in his or her ability to participate in regular physical activity also demonstrated a total difference of 7.6%.

difference of 7.6%. The application of weighting factors for income had the next largest impact, with a total difference of 5.2% while weighting for age only resulted in a 0.9% total difference. For total years of schooling, the largest differences following weighting emerged in the response categories on the two extremes ("strongly disagree" and "strongly agree"), as was the case for the item related to support for same-sex marriages.

Application of weighting factors for total years of schooling revealed a slight liberal bias in the data prior to weighting. The proportion of respondents disagreeing[31] that Canada should support the United States in all facets of its war on terrorism decreased slightly from approximately 52% before weighting to 49% following poststratification along the dimension total years of schooling. Thus, unweighted data provided slightly less support for the war on terrorism than did data where the education bias was adjusted for.

Table 4.6. Impact of poststratification on item "Canada should be as open to immigrants/refugees now as it was before September 11, 2001" (Alberta Survey 2003)

Response Category	Proportion of Sample (%)						
	Before Weight Applied	After Age Weighting	Difference (Age)	After Years of School Weighting	Difference (Schooling)	After Income Weighting	Difference (Income)
Strongly disagree	13.0	13.0	0.0	15.6	2.6	12.6	0.4
2	22.4	22.3	0.1	22.7	0.3	22.5	0.1
3	23.4	23.5	0.1	23.1	0.3	23.9	0.5
4	22.6	22.8	0.2	22.0	0.6	23.1	0.5
Strongly agree	18.6	18.4	0.2	16.6	2.0	17.8	0.8
Total Difference			***0.6***		***5.8***		***2.3***

Results for the 2003 Alberta Survey item that asked respondents if "Canada should be as open to immigrants/refugees now as it was before September 11, 2001" were also most

[31] Includes respondents who "strongly disagreed" or "disagreed" with the survey item.

biased as a function of total years of schooling, followed by individual income (see Table 4.6). After applying the weighting factors for total years of schooling, the total difference between proportions was 5.8%. After weighting for individual income the total difference observed was 2.3%. Applying the weighting factors for age only produced a 0.6% difference. Once again, the largest differences before and after the weighting factors for total years of schooling were applied occurred in the response categories on the two extremes ("strongly disagree" and "strongly agree"). Thus, liberal bias was again evident prior to poststratification, as unweighted results demonstrated more support for openness to immigrants/refugees.

Table 4.7. Impact of poststratification on item "How would you assess the influence of environmentalists in Alberta on government?" (Alberta Survey 2003)

Response Category	Proportion of Sample (%)						
	Before Weight Applied	After Age Weighting	Difference (Age)	After Years of School Weighting	Difference (Schooling)	After Income Weighting	Difference (Income)
Too little influence	11.3	11.3	0.0	10.2	1.1	11.4	0.1
2	27.6	27.7	0.1	25.3	2.3	27.9	0.3
3	39.4	39.2	0.2	39.1	0.3	38.9	0.5
4	15.3	15.4	0.1	17.4	2.1	15.5	0.2
Too much influence	6.4	6.5	0.1	8.0	1.6	6.2	0.2
Total Difference			***0.5***		***7.4***		***1.3***

As has been the case with all the dependent variables examined thus far, responses to the 2003 Alberta Survey item concerned with the public's opinion of the influence of environmentalists on Alberta government were most biased along the dimension total years of schooling, followed by individual income and, lastly, by age. Table 4.7 indicates that the largest total difference, 7.4%, occurred after application of the weighting factors for total years of schooling. Once again, a slight liberal bias is present in the unweighted

data when compared to data poststratified on the basis of education. Weighting for individual income produced a 1.3% total difference, and the result of weighting for age was a mere 0.5% total difference. Unlike the pattern that has been observed thus far, the response categories most affected by bias were not on the extremes, but rather were response options "2" and "4" – the categories on either side of the middle response option.

Summing up, it is evident that there was much more bias – that is, larger total difference in proportions before and after weighting – arising as a result of lack of representativeness in the total years of schooling dimension than in either individual income or age. When results of the index of dissimilarity analyses (presented earlier) are considered, these findings are to be expected. The index of dissimilarity for age did not display a consistent upward or downward trend and was the lowest of all the dimensions analyzed, indicating that Alberta Survey data were the most representative of the Alberta population along this dimension when compared to the others analyzed. The index of dissimilarity for individual income did display an upward trend and the ID scores were much higher than were those for age. Total years of schooling showed a clear upward trend and its ID scores were the largest of all dimensions examined, thereby indicating that Alberta Survey data were the least representative of the Alberta population along this dimension.

It is also worth mentioning that the higher education bias tended to result in more liberal results for the survey items examined. In addition, the survey item most affected by bias, the item associated with support for same-sex marriages, was the item asked most recently (in the 2005 Alberta Survey). This observation could lead to one of two

conclusions: Either there is something about the item itself which renders it quite susceptible to nonresponse bias, or this finding could be indicative of an increasing liberal bias over time as a result of the growing overrepresentation of individuals with more schooling. It is likely that both factors are at work in this instance.

Cumulative Effects of Bias

These analyses clearly demonstrate how survey data which are unrepresentative on certain sociodemographic dimensions can lead to bias in other survey variables with which they are significantly related. The analyses also show how a larger degree of unrepresentativeness, as was the case for total years of schooling, can lead to more substantial bias in other survey variables. What is not apparent, however, is how the bias present in various dimensions, such as age and total years of schooling, can interact. For example, there may be a number of dimensions within a survey that are not representative of the population from which the sample was drawn. Each of these dimensions could be affected by bias, and more than one dimension may be significantly related to another survey variable.

For example, consider the hypothetical case of variable Z, which is a key dependent variable of interest for a researcher. If both age and total years of schooling are significant predictors of variable Z and there is bias inherent in both of them, then there may be a cumulative effect on variable Z. That is, the overall bias in variable Z cannot be traced back to only the bias in age or only the bias in total years of schooling, but to the bias inherent in both of these predictor variables. Thus, the greater the number of biased predictor variables significantly related to the variable(s) of interest, the more likely there

will also be a higher degree of bias in the target variables. Unfortunately it is outside the scope of this study to pursue the measurement of cumulative bias, but it is nonetheless an important concept to be aware of.

Discussion

This chapter has presented a variety of results from a number of different stages of analysis. Some prominent and consistent trends have emerged. All the results indicated that the bias present in variables related to level of respondent education is cause for concern. Findings from the index of dissimilarity analyses suggest that Alberta Survey data are biased toward individuals with more schooling, as well as towards those with higher income. Bias along both of these dimensions seems to be increasing over time. Alberta Survey data appear to be more reflective of the population in terms of age and marital status, although there is a slight bias towards individuals who are married or common-law, and a corresponding underrepresentation of those who were never married.

The results pertaining to level of education are particularly concerning when one considers the outcome of the regression analyses. Respondent education is a predictor variable for a wide range of attitudes and behaviours across the areas of health, social issues, environmental issues, and crime- and surveillance-related issues. Thus, the attitudes of Albertans with more schooling are overrepresented on a wide array of topics included in the Alberta Survey.

The implications of such overrepresentation become clearly apparent upon examination of the changes in the distributions of attitude items following poststratification along the dimension total years of schooling. The 2005 Alberta Survey

item asking respondents if gays and lesbians should have the right to get married is particularly illustrative of how correcting for bias can alter survey estimates. Prior to weighting, and therefore where those with more education were overrepresented, under half of all survey respondents (48%) disagreed[32] that gays and lesbians should have the right to get married. However, after weighting factors were applied, the proportion disagreeing increased to about 56% – well over half. One can envision the potential policy and/or political implications associated with such a difference in survey estimates.

It is possible that because the Alberta Survey is conducted by a university-affiliated organization, a fact which is made clear to potential respondents in the introduction of the survey, that there may be a kind of university "halo effect" occurring. That is, individuals with more education may be more inclined to view the university in a favourable light and thus agree to participate in a survey for which the university is perceived to be the sponsoring organization. However, the results of this study do support previous studies suggesting that those with higher education and/or income (or socioeconomic status) are more likely to become survey respondents (see Cannell et al. 1987 in Groves and Lyberg 1988; Ellis, Endo and Armer 1970; Goyder 1987; Groves 1989; Keeter et al. 2000; Nathan 2001; O'Neil 1979).

Furthermore, there is evidence to suggest that biased results favouring those with more education and higher income are not likely confined to a particular survey or survey topic conducted by a particular kind of organization. For example, results of the 2006 Golf Participation in Canada Survey, a national survey conducted by Ipsos Reid, suggesting that "golf participation is on the upswing in Canada" were questioned by

[32] Including respondents who "strongly disagreed" or "disagreed" with the right to same-sex marriage.

representatives of the golf industry (Grange 2006, S8). One representative interviewed stated that the industry is in fact "'experiencing zero growth'" and that "'those [survey] numbers seem to contradict our own findings'". Such a discrepancy between industry knowledge and survey data may stem from an education and/or income bias among survey respondents as golf is traditionally a sport that is enjoyed by those of the middle to upper classes, that is, by those with more education and more money. If a higher education and/or higher income bias does exist among survey respondents, then the activities of those whom are more likely to be golfers could be overrepresented. Hence, survey results may be suggestive of growth of the sport when in actuality it is possible that no such growth exists.

The results of this chapter are also significant in terms of the methods used. Namely, the findings that emerged through the poststratification step confirmed the results of the index of dissimilarity analyses. Index of dissimilarity scores were greatest for total years of schooling. Similarly, poststratifying along the same dimension consistently produced a greater total difference in the before-and-after distributions of attitude and behaviour items when compared to the differences observed following poststratification for age and individual income. Thus, two separate analyses both yielded results suggesting a comparatively high degree of bias in the variable total years of schooling.

Such consistency across analyses not only strengthens the conclusions drawn regarding an education bias, but also offers support for the validity of the index of dissimilarity as a tool for measuring nonresponse bias. As mentioned earlier, the index of dissimilarity has not yet been used in such a capacity in published literature but the

results of this study suggest it has great potential in this context.[33] These results, combined with its ease of calculation and interpretation, render the index of dissimilarity a promising tool for the measurement of nonresponse bias in future studies.

This chapter has demonstrated that index of dissimilarity scores have been increasing over time, and therefore that representativeness of Alberta Survey data has been decreasing, at least along the dimensions education and income. In Chapter 2 we saw that over the same time period response rates to the Alberta Survey have been rapidly declining. Examining these two trends in concert suggests a positive relationship between response rates and representativeness of data obtained, as has been suggested by previous research (see Bethlehem 2002; Novo, Hammarstrõm and Janlert 1999; O'Neil 1979; Voogt and Van Kempen 2002).

The literature review conducted in the previous chapter revealed the importance of distinguishing between the various types of nonresponse when studying characteristics of nonrespondents. However, in the analyses subsequently conducted no such distinction was made and it is important to briefly address this issue. The biases discussed in relation to the Alberta Survey are overall biases only as, due to the nature of the survey (an RDD telephone survey), no information is available for nonrespondents. Thus, it is not possible to consider the characteristics of refusers separately from those of noncontacts and other noninterviews. Rather, we are only able to determine the broad characteristics of all nonrespondents, for example that they appear to have fewer years of schooling and lower levels of income, and are less likely to be married, than is the case

[33] The Population Research Lab has employed the index of dissimilarity to provide an indication of the representativeness of survey data along the dimensions age and marital status (see Population Research Lab 1991-2005).

for respondents. Therefore, while type of nonresponse is an important element to consider in any nonresponse study, it was simply not viable to distinguish between nonrespondents in this research project.

The analyses presented to this point have nonetheless provided insight into both the extent and implications of declining response rates to household telephone surveys within a Canadian context. The conclusions drawn from this research are presented in the concluding chapter (Chapter 5). In addition, as telephone surveys are an often used method of research, techniques for minimizing the effects of nonresponse bias have been developed. The most common of these methods are briefly outlined in the concluding chapter, followed by consideration of the future challenges telephone survey researchers will likely face.

Chapter 5. Conclusions and Future Challenges

The goal of this research project was to investigate the extent and nature of declining response rates in household telephone surveys as well as the implications of the decline. Based on the literature reviews and analyses conducted, a number of conclusions can be drawn. Following presentation of these key conclusions, the most common methods currently used by researchers to address the problem of nonresponse bias are briefly outlined. Finally, future challenges that telephone survey researchers will likely face, along with suggestions for future research, are considered.

Conclusions

The analyses of Alberta Survey data confirmed that response rates are indeed rapidly declining and that this decline is more pronounced in later years. The Alberta Survey witnessed a 48% decline in response rates over a fifteen year period, falling to only 26% by 2005. A steady rise in refusals and a more recent increase in noncontacts appear to be the primary culprits for falling response rates. The trend lines for response rates, as well as the components of nonresponse, suggest that it is highly unlikely that response rates will rise beyond their current levels. Rather, it is more probable that response rates will become at least somewhat lower before reaching a point where they level off. Current trends in response rates pose serious challenges to survey research.

Moreover, the trends occurring in the Alberta Survey are similar to trends occurring in surveys conducted by other university-affiliated organizations, such as the Survey of Consumer Attitudes conducted by the University of Michigan. While the degree of the

decline may vary across surveys, the pattern that both response and refusal rates follow is similar.

The patterns followed by the components of nonresponse provide insight into possible reasons for declining response rates and can serve as a useful indicator of social and technological changes in society (see Tourangeau 2004). For example, the steady rise in refusals lends support to the notion of householder frustration with over-surveying. Similarly, the more recent growth in noncontacts corresponds with the adoption of call screening technology, such as caller ID, to avoid unwanted calls. The combination of over-surveying and availability of call screening devices is likely significant in the recent increase in noncontacts. Growing privacy- and confidentiality-related concerns could easily play into the rising refusal and noncontact rates.

As response rates to the Alberta Survey have been declining, index of dissimilarity scores, representing nonresponse bias, have been increasing. Consideration of these two trends together indicates that, in the Alberta Survey, there is a positive relationship between response rates and representativeness of data obtained. The dimensions education and individual income are impacted most by nonresponse bias and thus provide the greatest cause for concern. Moreover, the bias present in these two dimensions is growing over time, rendering Alberta Survey data increasingly biased toward individuals with higher levels of both education and income.

The education bias is particularly disconcerting as level of education is a predictor variable for a wide range of attitudes related to health, social issues, environmental issues, and crime- and surveillance-related issues. Thus, the overrepresentation of individuals with higher levels of education could lead to biased results for a wide range

of topics, thereby undermining the very purpose of a sample survey, that is, to accurately represent the views of the population sampled. These findings begin to call into question the validity of random-digit-dialed household telephone surveys as they are currently conducted. Consequently, if current trends continue, it will become increasingly important for researchers to seriously evaluate the ability of this research method to provide them with good, valid data and, if necessary, to revise current data collection methods or to find alternatives.

Finally, consistency of results across the various methods employed in this study suggests that the index of dissimilarity is a valid tool for measuring nonresponse bias. The results which have been presented throughout the study support further use of the index of dissimilarity in this capacity.

Minimizing the Effects of Nonresponse Bias

The challenges associated with nonresponse bias are not new to survey researchers, although this study does suggest that they are becoming more pronounced over time. However, researchers have developed methods to minimize the effects of nonresponse bias. There are two broad approaches to such minimization, and both can be utilized in a single survey. The first attempts to reduce nonresponse during the data collection phase and therefore minimize nonresponse bias, while the goal of the second is to correct for nonresponse bias through post-survey adjustment. The following discussion is not meant to be a comprehensive analysis of the methods used to minimize and/or correct for nonresponse bias. Rather, I provide a brief overview of how researchers are currently attempting to deal with the challenges posed by nonresponse bias.

Reduction of nonresponse during data collection

Reduction of nonresponse during the data collection phase is a preventative method of dealing with nonresponse. The goal is to minimize nonresponse and therefore the error, or bias, associated with it. Techniques that are used to minimize nonresponse generally focus on extended interviewer efforts, such as increased number of callback attempts and refusal conversion, combined with the associated interviewer training (see Drew, GTE Laboratories and Groves 1989; Groves and Couper 1998; Lynn et al. 2002; Weisberg 2005). Changes to the survey methods can also be made, such as lengthening the data collection period to allow more opportunities for response, sending advance letters (which typically does not work well in random-digit-dialed telephone surveys), or including some kind of incentive for respondents (see, for example, Weisberg 2005). Well-trained and experienced interviewers can also attempt to minimize nonresponse through employing techniques such as tailoring the interview request to individual respondents rather than simply following a scripted introduction (Groves and Couper 1998; Weisberg 2005).

However, time and cost constraints can limit the degree to which researchers are able to make use of such preventative measures (see, for example, Lynn and Clarke 2002; Weisberg 2005). In addition, the ability of extended interviewer efforts to reduce nonresponse bias may vary depending on the variables included in the study. For example, Lynn et al. (2002) found that extended efforts were successful at significantly reducing nonresponse bias for certain income and health variables, but not for attitudinal measures. Thus, the resources required for extended efforts must be weighed against the

benefits that such efforts would likely produce, and this evaluation requires consideration of the key variables of interest in a survey.

Finally, it is important to note that it is virtually impossible to eliminate nonresponse completely. Thus, while preventative measures such as those discussed here may reduce nonresponse bias, it is very probable that bias will still impact results to some extent, albeit likely to a lesser degree than would be the case if extended efforts were not made.

Post-survey adjustment

As it is almost certain that nonresponse will be a component of all surveys, post-survey adjustment is a popular method of minimizing the effects of nonresponse bias. Post-survey adjustment generally includes methods such as weighting the data (including poststratification), imputation,[34] or modeling nonresponse[35] (Groves, Cialdini and Couper 1992; Weisberg 2005). While the difficulty of both assessing and subsequently correcting for the "negative effects of nonresponse" is emphasized by Bethlehem (2002, 287), weighting adjustments, such as poststratification, are often viewed as providing greater accuracy to survey estimates. For example, Gelman and Carlin (2002, 291) state that "considerable gains can be made by poststratifying on variables that are predictive of survey outcomes."

However, there are limitations to post-survey adjustment techniques. For example, in their study of nonresponse bias in the Dutch National Election, Voogt and Van Kempen

[34] Essentially, imputation involves inserting values for missing data (Weisberg 2005). There are a variety of types of imputation, but one which may be used for unit nonresponse involves the use of "matched substitutes" to impute data for nonrespondents (see Rubin and Zanutto 2002 in Weisberg 2005, 198). However, this approach is somewhat limited as it requires that background covariate variables are available for nonrespondents.

[35] Model-based procedures model the nonresponse process and can be used, for example, to correct for selection bias (Weisberg 2005, 196-197).

(2002) found that bias in political and voting behaviours of respondents was larger than bias in background variables, meaning that there was not a clear relationship between demographic variables and the key variables of interest (political and voting behaviours). Hence, weighting the data based on demographic information would not correct for the bias in the results. In order for post-survey statistical adjustments such as weighting to be effective in reducing bias, the weighting variables must be predictive of, or related to, key variables of interest (see Gelman and Carlin 2002; Weisberg 2005). In addition, relevant population data is often very limited (if available at all) for the survey populations of interest to researchers, thereby limiting the degree to which post-survey adjustment techniques can be used.

Thus, while in many cases post-survey adjustment enables a reduction of the discrepancies between particular survey estimates and population values, it is not without flaws or limitations. Nonetheless, such adjustment is perhaps the best method currently available to researchers attempting to minimize the effects of nonresponse bias in their data sets. It is important that those who use these methods are aware of the limitations and take them into consideration when engaging in adjustment procedures.

Future Challenges and Response to Them

While telephone survey research has become firmly entrenched as a method of information gathering in contemporary society, this study has demonstrated it is not without challenges. In fact, the current challenges faced by this research method are likely to become more pronounced in the future while new challenges will most certainly emerge. In order to be effective and remain relevant, telephone survey researchers must

respond and adapt to these challenges rather than maintaining the status quo (see Zukin 2006). The challenges themselves, consideration of possible responses to these challenges, and suggestions for future research are the focus of the final section of this thesis.

Future challenges

The primary challenge faced by telephone survey researchers is maintaining the ability to obtain valid survey results, that is, obtaining samples of respondents which are representative of the population of interest. Two trends pose a threat to this ability (Zukin 2006): The first has been a primary focus of this thesis – declining response rates. The second threat, not yet addressed in this thesis, is related to coverage of the population. Specifically, the growth of cellular phones as the primary or even the sole means of contacting individuals serves to exclude a slowly expanding proportion of the population from random-digit-dialed sampling frames.

In many countries around the world, including Canada and the United States, cell phones are becoming more prevalent, both as a complement to landline telephones and as an alternative to them (see Blumberg, Luke and Cynamon 2006; Callegaro and Poggio 2004; Keeter 2006; Leung and Wei 1999; McDonald 2006; Nathan 2001; Pew Research Center 2006; Sciadas 2002; Statistics Canada 2006c; Tourangeau 2004). Looking at Canada in particular, there were 16.6 million subscribers to mobile communication services by the end of 2005 (McDonald 2006). Results from the Residential Telephone Service Survey, conducted by Statistics Canada in 2005, showed that the proportion of Canadian households relying solely on cell phones more than doubled from 2003 to 2005,

rising from 1.9% to 4.8% (Statistics Canada 2006c). The same study indicated that Alberta had the second highest proportion of cell phone-only homes in Canada at 5.8%.[36] These numbers are slightly lower than those for the United States, with 7% to 9% of Americans estimated to rely solely on cell phones (Pew Research Center 2006).

Cell phone-only households are problematic from the standpoint of telephone survey researchers as it is currently very difficult to include these households in RDD sampling frames. For example, in both Canada and the United States, the owner of the cell phone is required to pay for all incoming calls. Thus, contacting an individual on his or her cell phone costs the survey respondent money, meaning that a mechanism of reimbursement would be necessary if these numbers were included in sampling frames. In a study conducted by the Pew Research Center (2006) in the United States designed to assess the feasibility of including cell phone numbers in a telephone survey sampling frame, respondents were offered a $10 incentive to cover the costs incurred. This incentive was accepted by 86% of cell phone respondents, and led to much higher survey costs resulting from the incentive itself as well as the associated administrative work required. Overall, data collection costs for the cell phone sample were more than double what they were for the landline sample (Pew Research Center 2006, 9-10). Long distance charges could pose particular problems as, in many surveys, respondents do not reside in the local calling area of the administering organization.

In addition, the exchanges of cell phone numbers are often different from those of landlines and may not correspond as closely to particular geographic areas as the

[36] British Columbia had the highest proportion of cell phone-only homes (7.1%), followed by Alberta (5.8%), and Quebec (4.8%) (Statistics Canada 2006c).

exchanges of traditional telephone lines do. As a result, new banks of exchanges would have to be developed and new strategies employed in the random generation of numbers to sample populations from specific geographic areas via cell phones.

There is some evidence to suggest that there are differences between cell phone-only households and other households. Canadians who rely solely on cell phones tend to be lower-income and live in large urban centres (Statistics Canada 2006c). American studies indicate that individuals who are lower-income, younger, renting, and living alone or single are more likely to opt for a cell phone instead of a landline (see Blumberg, Luke and Cynamon 2006; de Leeuw, Lepkowski and Kim 2002; Keeter 2006; Pew Research Center 2006). A media source (Makris 2003) suggests that younger persons are most likely to become part of the cell phone-only population as "cellphones [*sic*] match youths' mobile lifestyles". These demographic differences have the potential to produce biased results for survey items with which they are correlated, particularly if the proportion of cell phone-only households continues to grow.

While the proportion of cell phone-only households may currently seem relatively small, there are no indications that the penetration of this mobile technology will slow or diminish. Rather, current trends suggest exactly the opposite – that cell phones will continue to grow in popularity both as a complement and an alternative to traditional landline telephones, thereby exacerbating the challenges currently faced as a result of cell phone growth.

Other challenges already discussed in the introductory chapter of this thesis will likely become more pronounced. For example, implementation of the national 'Do Not Call' registry in Canada may pose problems for telephone survey researchers, depending

upon the final regulations and exemptions included in the associated policies. In addition, continued over-surveying and telemarketing, accompanied by SUGGING and FRUGGING, could very well continue to increase householder frustration with unsolicited calls, including valid survey requests. As frustration with such calls continues to increase, it is likely that both refusals and the use of call screening devices will also continue to rise, thereby creating more hurdles in the attempt to access potential survey respondents.

Where do we go from here?

It is clear that telephone survey research does not have an easy road ahead. In fact, the challenges it faces are so great that some researchers seem to have little hope for the future of this research method. For example, Van Goor and Rispens (2004, 47) lament that "the future looks grim for the telephone survey as a research instrument". Similarly, based on findings from their study on nonresponse, Steeh et al. (2001, 243) state: "telephone surveys in general and RDD surveys in particular will become less reliable and valid in the twenty-first century."

So, are we witnessing the end of an era, so to speak, where the relevance and validity of the telephone survey as a research instrument is diminished? While perhaps overly dramatic in nature, this question is certainly pertinent today, particularly in the context of the current study. Despite the somewhat sobering results of this study and the challenges that have just been articulated, I would be very hesitant to provide either a clearly positive or negative response to the question posed. The challenges telephone survey

researchers are facing today may be different in form and/or degree than those faced in the past, but that is not to say there is no hope of contending with them.

In fact, new obstacles and challenges are often a driving force behind innovation, and thus should not be viewed in a purely negative light. Rather, they provide opportunity for change and growth. As Cliff Zukin, recent president of the American Association for Public Opinion Research (AAPOR), states, "we need to innovate and adapt so as to continue to be relevant" (Zukin 2006, 432). Thus, to contend with the 'double whammy' posed by declining response rates and growing coverage problems, survey researchers must display flexibility and creativity while maintaining a commitment to rigorous research methods and designs. This is, to say the least, a tall order.

What may be required is a re-evaluation of the function of telephone surveys. For example, while current trends suggest that the quality of data produced by some RDD household telephone surveys administered by non-governmental organizations may be declining, government-administered surveys seem to be faring much better. For example, response rates to the General Social Survey administered by Statistics Canada (examined in Chapter 2) are still above 70%. Thus, RDD household telephone surveys conducted by the federal government in Canada still appear to be quite effective. As hypothesized in Chapter 2, comparatively high government response rates are likely the result of three factors: perceived legitimacy; perceived status; and frequent requests for information by government. It is quite probable that the role of the sponsoring organization or, more specifically, public perception of the sponsoring organization, is becoming increasingly important in a society inundated with survey requests.

What then becomes of the non-governmental organization that wishes to use an RDD telephone survey as the primary research method? There are two broad strategies to consider. The first involves developing improved sampling strategies that enable the inclusion of cell phone-only households. This kind of innovation will become more important as cell phone dependence continues to grow. The second necessitates a reconsideration of research design to increase response rates. For example, declining response rates have already pushed researchers to use mixed mode designs more often (Dillman and Christian 2005). These designs may employ a variety of mediums to achieve survey response, such as the telephone, internet, and/or mail. Although mixed mode designs certainly have their own set of challenges to contend with, for example, mode effects and the issue of cognitive equivalence of survey items (see, for example, Cobben, Schouten and Bethlehem 2006; Dillman and Christian 2005), they do provide an alternative to the 'pure' telephone survey method which is currently struggling.

While there is no clear solution to the challenges faced by telephone survey researchers (and especially those conducting non-governmental RDD household surveys), what is clear is that the status quo is, in many cases, declining in effectiveness. As current trends continue and response rates remain at a very low level, the space for bias to enter into survey results becomes ever wider and the threat to validity higher. Change and innovation of some form are required. At this point in time, the future of RDD household telephone surveys remains tenuous. This uncertain future is somewhat unsettling given the extent to which telephone survey data are currently collected and used for purposes ranging from scholarly research, to the shaping of government communications strategies (Page 2006), to planning and decision-making in both the

private and public sectors (see, for example, Gandy 2003; Gazso and Haggerty forthcoming; Herbst 1993; Tourangeau 2004). Survey researchers have a daunting but essential task ahead of them in attempting to address the response rate challenge and coverage issues threatening this widely popular research tool.

Suggestions for future research

Further research in several areas would help determine a direction for telephone survey research as well as clarify the factors most important in decisions of survey participation. Based on the findings presented in this thesis, I suggest that further investigation in five specific areas is pertinent to the current situation of telephone survey research. The first three suggestions are broadly related to developing a greater understanding of who responds to surveys, why, and when, and what effect this has on survey estimates. The last two suggestions focus on continuing to search for ways to deal with the current reality of very low response rates and, consequently, increasing levels of nonresponse bias.

1. Role of the sponsoring organization in survey participation

As has been discussed at several points in this thesis, the sponsoring organization seems to be an important variable in response rate. Namely, government surveys consistently achieve much higher response rates in RDD household telephone surveys than do other organizations. While several reasons for this have been hypothesized, further research into what exactly it is about sponsoring organization that encourages response would be useful information for survey researchers.

In addition, results of this study point to a higher education bias in a university-administered survey. Such a bias is suggestive of a university "halo effect" where those with more education are more likely to respond to survey requests from a university-affiliated organization. Research into the interaction between sponsoring organization and response rate for population subgroups would help clarify why certain people will participate in surveys conducted by certain organizations, but others will not.

2. Relationship of nonresponse bias to the sponsoring organization

The biases found in this study were in the direction of higher education and higher income. However, whether these biases are a function of the sponsoring organization (the university) or whether they are indicative of a trend that is occurring across a variety of surveys is currently unclear. Further research is needed to clarify the degree to which similar biases characterize other surveys.

3. The cell phone-only population

It is clear that the cell phone-only population is growing in both Canada and the United States and that it poses a significant challenge to survey research. Currently, there is limited information available on the characteristics of the cell phone-only population and how this trend will affect the quality of estimates obtained through RDD household telephone surveys. Research is needed to fill these gaps in knowledge. In addition, more research needs to be done on how survey researchers can address this growing challenge.

4. Methods of minimizing the effects of nonresponse bias

As nonresponse will remain a component of virtually all surveys, research on how survey researchers can minimize the effects of nonresponse bias continues to be important. Minimizing survey nonresponse and the use of post-survey adjustment techniques are both areas of much relevance that deserve continuing attention.

5. Alternatives to RDD household telephone surveys

Finally, low response rates in household telephone surveys have become a reality for many researchers. The future of the telephone survey is somewhat uncertain, and thus alternative methods of gathering information from the general population require exploration. Further research into alternative research design strategies to contend with telephone survey nonresponse is much needed, and will likely play an important role in determining the direction of future data collection.

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Appendix A. Conceptual Model of Survey Participation from Groves and Couper (1998, 30)

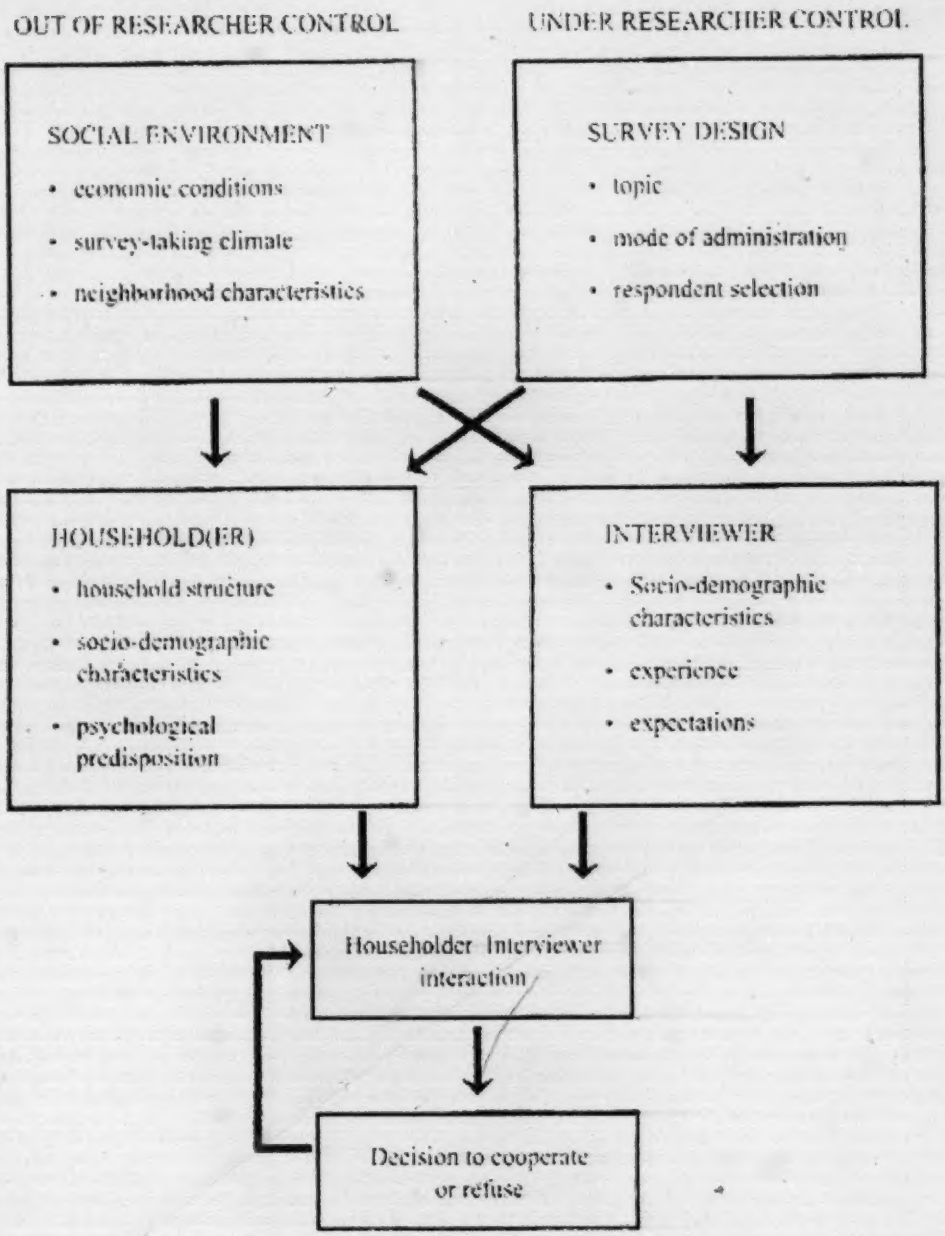

Figure 2.3. A conceptual framework for survey cooperation.

Appendix B. Index of Dissimilarity "Number of Categories" Experiment

Research Question

Does the number of categories employed for a given variable impact the results of index of dissimilarity calculations?

Method

The number of categories for the variables "total years of schooling" and "individual income" were systematically altered for the 2002 Alberta Survey. The number of categories used for total years of schooling was increased from four to seven, and for income the number of categories was decreased from ten to five.[1]

Results

Table B.1. Results of index of dissimilarity "number of categories" experiment

	2002 Alberta Survey		2001 Census Data		
	Valid Cases	*Percentage (A)*	*Valid Cases*	*Percentage (B)*	*Difference (B-A)*
ORIGINAL CATEGORIES					
Total Years of Schooling	1202		2187897		
Less than 9 years		2.08%		6.63%	4.55%
9-12 years		26.37%		43.40%	17.02%
13-17 years		57.57%		41.25%	16.32%
18 or more years		13.98%		8.72%	5.25%
				Index of Dissim.	***21.57%***
Income (Individual)	957		2187897		
< $16000		25.91%		35.18%	9.26%
$16000 - 25999		15.15%		18.10%	2.95%
$26000 - 35999		14.94%		14.30%	0.64%
$36000 - 44999		11.70%		9.84%	1.86%
$45000 - 54999		10.87%		7.40%	3.47%
$55000 - 64999		6.79%		5.24%	1.55%
$65000 - 74999		4.60%		3.10%	1.50%
$75000 - 84999		2.40%		2.06%	0.34%
$85000 - 99999		2.19%		1.55%	0.64%
$100000+		5.33%		3.22%	2.11%
				Index of Dissim.	***12.16%***
EXPERIMENT					
Total Years of Schooling	1202		2187897		
< 5 years		0.08%		1.22%	1.14%
5-8 years		2.00%		5.41%	3.41%
9-10 years		5.49%		10.21%	4.72%
11-12 years		20.88%		33.18%	12.30%
13 years		10.98%		9.27%	1.71%

Table B.1 cont'd

14-17 years	46.59%	31.98%	14.61%
18+ years	13.98%	8.72%	5.25%
		Index of Dissim.	***21.57%***
Income (Individual)	957	2187897	
< $16000	25.91%	35.18%	9.26%
$16000 - 35999	30.09%	32.40%	2.31%
$36000 - 54999	22.68%	17.24%	5.43%
$55000 - 74999	11.39%	8.34%	3.05%
$75000+	9.93%	6.84%	3.09%
		Index of Dissim.	***11.57%***

Table B.1 indicates that altering the coding scheme for total years of schooling made no difference in the subsequent index of dissimilarity calculations, and for income the difference was less than a percentage point (0.59%).

Conclusion

Based on the results of these analyses it is reasonable to conclude that if a different coding scheme was employed for the variables in this study, the impact on the results would be minimal. Neither the index of dissimilarity for the variable "total years of schooling" nor for the variable "individual income" was significantly affected by changing the number of categories by up to 50%.

Appendix C. Index of Dissimilarity Calculations for 1991, 1996, 2002, and 2005

Table C.1. Index of dissimilarity calculations for 1991

ALBERTA TOTAL				
Age Groups	1343		1800032	
18-24		12.81%	14.23%	1.43%
25-34		31.42%	27.11%	4.32%
35-44		23.31%	23.09%	0.21%
45-54		12.36%	13.51%	1.15%
55-64		8.49%	10.20%	1.71%
65-74		7.37%	7.53%	0.16%
75+		4.17%	4.33%	0.16%
			Index of Dissim.	***4.56%***
Marital Status	1344		1800032	
Single (never married)		19.79%	25.56%	5.76%
Married*		64.66%	59.68%	4.98%
Separated		3.42%	2.86%	0.56%
Divorced		6.62%	6.97%	0.35%
Widowed		5.51%	4.93%	0.57%
			Index of Dissim.	***6.11%***
Highest Level of Education	1343		1798332	
Less than high school		22.56%	32.49%	9.93%
High school graduate		20.10%	13.11%	6.99%
Some non-university		30.23%	30.78%	0.55%
Some university		27.03%	23.62%	3.41%
			Index of Dissim.	***10.44%***
Total Years of Schooling	1342		1800032	
Less than 9 years		7.00%	9.78%	2.78%
9-12 years		37.63%	47.15%	9.52%
13-17 years		48.29%	37.00%	11.28%
18 or more years		7.08%	6.06%	1.01%
			Index of Dissim.	***12.30%***
Income (Individual)	1176		1800032	
< $16000		39.37%	44.69%	5.32%
$16000 - 25999		19.30%	19.25%	0.06%
$26000 - 35999		16.07%	14.37%	1.70%
$36000 - 44999		8.84%	8.41%	0.44%
$45000 - 54999		6.97%	6.09%	0.89%
$55000 - 64999		3.57%	2.86%	0.71%
$65000 - 74999		2.04%	1.56%	0.49%
$75000 - 84999		1.28%	0.88%	0.40%
$85000 - 99999		0.68%	0.68%	0.00%
$100000+		1.96%	1.23%	0.72%
			Index of Dissim.	***5.36%***

Table C.1 cont'd

EDMONTON ONLY				
Age Groups	489		606533	
18-24		17.59%	15.11%	2.47%
25-34		30.88%	27.39%	3.49%
35-44		22.29%	22.44%	0.15%
45-54		9.20%	13.75%	4.55%
55-64		7.57%	9.99%	2.42%
65-74		8.79%	7.32%	1.47%
75+		3.68%	3.99%	0.31%
			Index of Dissim.	***7.44%***
Marital Status	490		606533	
Single (never married)		26.53%	27.75%	1.22%
Married*		54.69%	56.79%	2.09%
Separated		4.08%	3.03%	1.05%
Divorced		7.96%	7.28%	0.68%
Widowed		6.73%	5.14%	1.59%
			Index of Dissim.	***3.31%***
Highest Level of Education	490		606533	
Less than high school		18.37%	30.39%	12.02%
High school graduate		18.57%	13.61%	4.96%
Some non-university		32.04%	30.94%	1.10%
Some university		31.02%	24.95%	6.07%
			Index of Dissim.	***12.07%***
Total Years of Schooling	489		606533	
Less than 9 years		5.73%	9.11%	3.39%
9-12 years		30.47%	46.40%	15.93%
13-17 years		54.40%	37.67%	16.72%
18 or more years		9.41%	6.81%	2.59%
			Index of Dissim.	***19.32%***
Income (Individual)	425		606533	
< $16000		39.53%	43.39%	3.86%
$16000 - 25999		20.00%	19.24%	0.76%
$26000 - 35999		18.59%	15.31%	3.28%
$36000 - 44999		9.65%	8.75%	0.89%
$45000 - 54999		5.65%	6.43%	0.78%
$55000 - 64999		2.59%	2.89%	0.30%
$65000 - 74999		1.88%	1.49%	0.39%
$75000 - 84999		0.47%	0.79%	0.32%
$85000 - 99999		0.47%	0.66%	0.19%
$100000+		1.18%	1.06%	0.12%
			Index of Dissim.	***5.44%***
CALGARY ONLY				
Age Groups	445		549733	
18-24		12.36%	14.16%	1.80%
25-34		31.24%	28.94%	2.29%
35-44		24.72%	24.36%	0.36%
45-54		15.51%	13.01%	2.50%

Table C.1 cont'd

55-64	8.31%	9.66%	1.34%
65-74	5.39%	6.18%	0.79%
75+	2.47%	3.69%	1.22%
		Index of Dissim.	***5.15%***
Marital Status	446	549733	
Single (never married)	24.89%	27.21%	2.33%
Married*	59.42%	57.69%	1.73%
Separated	3.59%	2.97%	0.62%
Divorced	7.85%	7.67%	0.18%
Widowed	4.26%	4.46%	0.20%
		Index of Dissim.	***2.52%***
Highest Level of Education	446	549199	
Less than high school	16.59%	26.17%	9.58%
High school graduate	21.97%	12.75%	9.22%
Some non-university	25.34%	30.22%	4.88%
Some university	36.10%	30.86%	5.24%
		Index of Dissim.	***14.46%***
Total Years of Schooling	446	549733	
Less than 9 years	3.14%	6.85%	3.71%
9-12 years	37.22%	41.86%	4.64%
13-17 years	52.02%	43.03%	8.99%
18 or more years	7.62%	8.31%	0.69%
		Index of Dissim.	***9.02%***
Income (Individual)	399	549733	
< $16000	33.33%	41.37%	8.04%
$16000 - 25999	18.80%	19.63%	0.84%
$26000 - 35999	21.05%	14.79%	6.26%
$36000 - 44999	8.77%	9.19%	0.41%
$45000 - 54999	9.02%	6.13%	2.89%
$55000 - 64999	3.51%	3.18%	0.33%
$65000 - 74999	1.75%	1.87%	0.12%
$75000 - 84999	1.25%	1.12%	0.13%
$85000 - 99999	0.50%	0.82%	0.32%
$100000+	2.01%	1.89%	0.11%
		Index of Dissim.	***9.73%***

* Includes those who responded "common law" in the Alberta Survey

Table C.2. Index of dissimilarity calculations for 1996

ALBERTA TOTAL				
Age Groups	1203		1931256	
18-24		10.56%	12.99%	2.43%
25-34		22.19%	22.36%	0.17%
35-44		26.93%	24.79%	2.14%
45-54		16.29%	16.81%	0.51%
55-64		11.14%	10.35%	0.78%
65-74		8.65%	7.77%	0.88%
75+		4.16%	4.93%	0.77%
			Index of Dissim.	***3.84%***
Marital Status	1210		1931256	
Single (never married)		21.16%	25.92%	4.76%
Married*		60.74%	58.62%	2.13%
Separated		3.55%	3.02%	0.53%
Divorced		8.10%	7.71%	0.39%
Widowed		6.36%	4.74%	1.63%
			Index of Dissim.	***4.72%***
Highest Level of Education	1211		1931256	
Less than high school		16.10%	29.89%	13.79%
High school graduate		19.98%	12.08%	7.90%
Some non-university		33.86%	33.30%	0.56%
Some university		30.14%	24.73%	5.41%
			Index of Dissim.	***13.83%***
Total Years of Schooling	1210		1931256	
Less than 9 years		4.55%	8.35%	3.81%
9-12 years		30.74%	45.18%	14.43%
13-17 years		53.72%	39.73%	13.99%
18 or more years		10.99%	6.74%	4.25%
			Index of Dissim.	***18.24%***
Income (Individual)	1017		1931256	
< $16000		33.04%	43.94%	10.90%
$16000 - 25999		17.80%	17.76%	0.04%
$26000 - 35999		16.91%	13.73%	3.18%
$36000 - 44999		11.21%	8.77%	2.44%
$45000 - 54999		6.98%	6.35%	0.64%
$55000 - 64999		4.03%	3.74%	0.29%
$65000 - 74999		2.95%	2.03%	0.92%
$75000 - 84999		1.97%	1.16%	0.81%
$85000 - 99999		1.77%	0.91%	0.86%
$100000+		3.24%	1.61%	1.63%
			Index of Dissim.	***10.85%***

Table C.2 cont'd

EDMONTON ONLY				
Age Groups	401		625896	
18-24		13.47%	13.26%	0.21%
25-34		25.19%	22.07%	3.12%
35-44		22.69%	24.26%	1.57%
45-54		15.71%	17.04%	1.33%
55-64		9.23%	10.41%	1.18%
65-74		8.23%	8.11%	0.12%
75+		5.49%	4.85%	0.64%
			Index of Dissim.	***4.08%***
Marital Status	402		625896	
Single (never married)		26.62%	26.91%	0.29%
Married*		52.24%	56.87%	4.63%
Separated		2.99%	3.16%	0.18%
Divorced		10.95%	8.11%	2.84%
Widowed		7.21%	4.95%	2.27%
			Index of Dissim.	***5.10%***
Highest Level of Education	405		625896	
Less than high school		14.81%	28.47%	13.65%
High school graduate		19.26%	12.07%	7.19%
Some non-university		34.07%	33.33%	0.74%
Some university		31.85%	26.13%	5.72%
			Index of Dissim.	***13.65%***
Total Years of Schooling	405		625896	
Less than 9 years		3.46%	8.31%	4.85%
9-12 years		27.90%	44.31%	16.40%
13-17 years		56.54%	39.96%	16.58%
18 or more years		12.10%	7.43%	4.67%
			Index of Dissim.	***21.25%***
Income (Individual)	350		625896	
< $16000		38.00%	43.59%	5.59%
$16000 - 25999		18.29%	17.80%	0.49%
$26000 - 35999		16.86%	14.55%	2.31%
$36000 - 44999		8.86%	8.93%	0.07%
$45000 - 54999		8.00%	6.52%	1.48%
$55000 - 64999		3.71%	3.74%	0.03%
$65000 - 74999		3.14%	1.96%	1.19%
$75000 - 84999		1.14%	0.95%	0.19%
$85000 - 99999		0.57%	0.70%	0.13%
$100000+		1.43%	1.27%	0.16%
			Index of Dissim.	***5.82%***

Table C.2 cont'd

CALGARY ONLY				
Age Groups	402		606384	
18-24		12.19%	12.61%	0.42%
25-34		22.14%	24.06%	1.92%
35-44		30.60%	26.19%	4.41%
45-54		16.92%	16.90%	0.02%
55-64		8.71%	9.40%	0.69%
65-74		6.97%	6.65%	0.32%
75+		2.49%	4.20%	1.72%
			Index of Dissim.	***4.74%***
Marital Status	404		606384	
Single (never married)		24.50%	27.97%	3.47%
Married*		57.43%	56.50%	0.92%
Separated		3.47%	3.22%	0.24%
Divorced		8.66%	8.34%	0.32%
Widowed		5.94%	3.96%	1.98%
			Index of Dissim.	***3.47%***
Highest Level of Education	403		606384	
Less than high school		12.41%	23.39%	10.98%
High school graduate		16.87%	11.68%	5.19%
Some non-university		29.78%	31.86%	2.09%
Some university		40.94%	33.06%	7.88%
			Index of Dissim.	***13.07%***
Total Years of Schooling	402		606384	
Less than 9 years		2.99%	5.62%	2.63%
9-12 years		25.62%	39.18%	13.56%
13-17 years		54.98%	45.58%	9.39%
18 or more years		16.42%	9.62%	6.80%
			Index of Dissim.	***16.19%***
Income (Individual)	335		606384	
< $16000		32.24%	40.82%	8.58%
$16000 - 25999		18.51%	17.75%	0.76%
$26000 - 35999		16.42%	13.85%	2.57%
$36000 - 44999		11.34%	9.52%	1.83%
$45000 - 54999		5.67%	6.49%	0.82%
$55000 - 64999		4.18%	3.88%	0.30%
$65000 - 74999		2.39%	2.39%	0.00%
$75000 - 84999		2.99%	1.38%	1.61%
$85000 - 99999		1.79%	1.27%	0.52%
$100000+		4.48%	2.66%	1.82%
			Index of Dissim.	***9.40%***

* Includes those who responded "common law" in the Alberta Survey

Table C.3. Index of dissimilarity calculations for 2002

ALBERTA TOTAL				
Age Groups	1173		2187897	
18-24		13.90%	13.79%	0.11%
25-34		21.31%	19.50%	1.81%
35-44		23.61%	23.60%	0.01%
45-54		18.84%	19.17%	0.33%
55-64		10.91%	10.95%	0.04%
65-74		7.59%	7.75%	0.17%
75+		3.84%	5.23%	1.40%
			Index of Dissim.	***1.93%***
Marital Status	1200		2187897	
Single (never married)		23.92%	28.59%	4.67%
Married*		61.33%	55.65%	5.68%
Separated		2.92%	3.00%	0.08%
Divorced		7.50%	8.16%	0.66%
Widowed		4.42%	4.60%	0.18%
			Index of Dissim.	***5.64%***
Highest Level of Education	1206		2187897	
Less than high school		12.35%	27.02%	14.67%
High school graduate		20.65%	12.05%	8.59%
Some non-university		30.10%	33.51%	3.41%
Some university		36.90%	27.41%	9.48%
			Index of Dissim.	***18.08%***
Total Years of Schooling	1202		2187897	
Less than 9 years		2.08%	6.63%	4.55%
9-12 years		26.37%	43.40%	17.02%
13-17 years		57.57%	41.25%	16.32%
18 or more years		13.98%	8.72%	5.25%
			Index of Dissim.	***21.57%***
Income (Individual)	957		2187897	
< $16000		25.91%	35.18%	9.26%
$16000 - 25999		15.15%	18.10%	2.95%
$26000 - 35999		14.94%	14.30%	0.64%
$36000 - 44999		11.70%	9.84%	1.86%
$45000 - 54999		10.87%	7.40%	3.47%
$55000 - 64999		6.79%	5.24%	1.55%
$65000 - 74999		4.60%	3.10%	1.50%
$75000 - 84999		2.40%	2.06%	0.34%
$85000 - 99999		2.19%	1.55%	0.64%
$100000+		5.33%	3.22%	2.11%
			Index of Dissim.	***12.16%***

Table C.3 cont'd

EDMONTON ONLY				
Age Groups	398		700014	
18-24		15.58%	14.42%	1.16%
25-34		20.85%	19.27%	1.58%
35-44		23.37%	22.86%	0.51%
45-54		17.59%	19.33%	1.74%
55-64		10.80%	10.97%	0.17%
65-74		8.54%	7.83%	0.71%
75+		3.27%	5.32%	2.05%
			Index of Dissim.	***3.96%***
Marital Status	405		700014	
Single (never married)		25.68%	29.82%	4.14%
Married*		58.77%	53.62%	5.14%
Separated		4.20%	3.08%	1.11%
Divorced		8.64%	8.66%	0.02%
Widowed		2.72%	4.81%	2.09%
			Index of Dissim.	***6.26%***
Highest Level of Education	406		700014	
Less than high school		11.58%	25.77%	14.19%
High school graduate		16.75%	11.79%	4.96%
Some non-university		31.28%	33.59%	2.31%
Some university		40.39%	28.85%	11.54%
			Index of Dissim.	***16.50%***
Total Years of Schooling	404		700014	
Less than 9 years		1.98%	6.17%	4.19%
9-12 years		23.02%	42.25%	19.23%
13-17 years		61.14%	41.95%	19.19%
18 or more years		13.86%	9.63%	4.23%
			Index of Dissim.	***23.42%***
Income (Individual)	329		700014	
< $16000		26.44%	34.72%	8.28%
$16000 - 25999		16.11%	18.57%	2.46%
$26000 - 35999		14.59%	14.76%	0.18%
$36000 - 44999		11.25%	10.02%	1.23%
$45000 - 54999		10.03%	7.39%	2.64%
$55000 - 64999		7.29%	5.29%	2.00%
$65000 - 74999		5.47%	3.16%	2.31%
$75000 - 84999		1.52%	2.00%	0.48%
$85000 - 99999		3.04%	1.47%	1.57%
$100000+		4.26%	2.61%	1.65%
			Index of Dissim.	***11.40%***

Table C.3 cont'd

CALGARY ONLY				
Age Groups	384		717296	
18-24		12.50%	13.27%	0.77%
25-34		23.96%	21.48%	2.48%
35-44		23.96%	24.76%	0.81%
45-54		18.75%	19.61%	0.86%
55-64		11.20%	9.72%	1.47%
65-74		6.51%	6.80%	0.29%
75+		3.13%	4.35%	1.23%
			Index of Dissim.	***3.95%***
Marital Status	397		717296	
Single (never married)		26.95%	30.61%	3.65%
Married*		56.42%	54.04%	2.39%
Separated		2.52%	3.13%	0.61%
Divorced		9.32%	8.38%	0.94%
Widowed		4.79%	3.85%	0.94%
			Index of Dissim.	***4.27%***
Highest Level of Education	400		717296	
Less than high school		7.75%	20.64%	12.89%
High school graduate		17.50%	11.34%	6.16%
Some non-university		27.75%	31.57%	3.82%
Some university		47.00%	36.44%	10.56%
			Index of Dissim.	***16.72%***
Total Years of Schooling	400		717296	
Less than 9 years		1.25%	4.71%	3.46%
9-12 years		20.25%	36.33%	16.08%
13-17 years		59.25%	46.87%	12.38%
18 or more years		19.25%	12.10%	7.15%
			Index of Dissim.	***19.54%***
Income (Individual)	303		717296	
< $16000		24.09%	31.91%	7.81%
$16000 - 25999		13.20%	16.86%	3.66%
$26000 - 35999		16.50%	14.66%	1.84%
$36000 - 44999		11.55%	10.32%	1.23%
$45000 - 54999		14.52%	8.48%	6.04%
$55000 - 64999		5.94%	5.76%	0.18%
$65000 - 74999		4.29%	3.36%	0.93%
$75000 - 84999		2.31%	2.19%	0.12%
$85000 - 99999		1.98%	1.73%	0.25%
$100000+		5.61%	4.73%	0.88%
			Index of Dissim.	***11.47%***

* Includes those who responded "common law" in the Alberta Survey

Table C.4. Index of dissimilarity calculations for 2005

ALBERTA TOTAL			
Age Groups	1191	2493376	
18-24	11.92%	13.93%	2.01%
25-34	18.14%	19.80%	1.66%
35-44	21.66%	20.69%	0.98%
45-54	21.41%	19.67%	1.74%
55-64	13.52%	12.26%	1.26%
65-74	7.72%	7.37%	0.35%
75+	5.54%	6.28%	0.74%
		Index of Dissim.	***4.37%***
EDMONTON ONLY			
Age Groups	386	760005	
20-24*	11.66%	10.62%	1.03%
25-34	19.17%	20.60%	1.43%
35-44	19.95%	20.94%	0.99%
45-54	21.76%	20.27%	1.49%
55-64	15.03%	13.03%	2.00%
65-74	7.77%	7.85%	0.07%
75+	4.66%	6.68%	2.02%
		Index of Dissim.	***4.52%***
CALGARY ONLY			
Age Groups	379	796655	
20-24*	7.65%	9.96%	2.31%
25-34	20.84%	22.61%	1.77%
35-44	25.59%	22.58%	3.02%
45-54	22.43%	20.78%	1.65%
55-64	11.35%	11.91%	0.56%
65-74	6.07%	6.61%	0.54%
75+	6.07%	5.56%	0.51%
		Index of Dissim.	***5.18%***

*Due to the data available through postcensal estimates, the category 18-24 years had to be changed to 20-24 years for Edmonton and Calgary. Thus, individuals 18-20 years old are excluded from this portion of index of dissimilarity calculations. 2005 age data were retrieved from Statistics Canada 2006a.

Appendix D. Variables Included in the Regression Analyses

Table D.1 Control and dependent variables included in regression analyses

Topic	Item Description	Survey Year
CONTROL VARIABLES		
Sex	*Interview records sex of respondent*	2002-2005
Age	What is your age?	2002-2005
Total years of schooling	In total, how many years of schooling do you have? This includes the total of grade school, high school, vocational, technical and university.	2002-2005
Marital status	What is your CURRENT marital status?	2002-2005
Urban/rural residence	Do you presently live in: a city, a town, a village, or a rural area?	2002-2005
Household size	*Total of number of adults and number of children reported to live in the household*	2002-2005
Home ownership	Do you (or your spouse/partner/parents) presently own or rent your residence?	2002-2005
Individual income	What was your own total INDIVIDUAL income for this past year BEFORE taxes and deductions?	2002-2005
DEPENDENT VARIABLES		
Health Issues	The government closely regulates the quality and services provided in long-term care facilities.	2005
	The provincial government should only be responsible for income subsidies that provide a minimum level of care for those people who cannot afford their own care.	2005
	How confident do you feel in your ability to participate in regular physical activity?	2005
Social Issues	I support more funding for public education in Alberta.	2002

Table D.1 cont'd

Topic	Item Description	Survey Year
Social Issues	I support more funding for public education in Alberta.	2002
	How would you describe the health of democracy in Alberta?	2003
	How would you assess the influence of big business [in Alberta]?	2003
	The Alberta government hides a lot of information from the people of the province.	2003
	Canada should support the US in all facets of its war on terrorism.	2003
	Canada should be as open to immigrants and refugees now as it was before September 11, 2001.	2003
	Too many people in Canada receive welfare/social assistance/government help.	2004
	Gays and lesbians should have the right to get married.	2005
Environmental Issues	How would you describe the health of the environment in Alberta?	2003
	How would you assess the influence of environmentalists [in Alberta]?	2003
	Protecting wilderness makes a positive contribution to the quality of life in Alberta.	2004
	In your opinion have health risks to the Alberta public from drinking tap water increased a great deal, increased somewhat, stayed about the same, decreased somewhat, or decreased a great deal in the past ten years?	2005
Crime- and surveillance-related Issues	Excluding the use of cameras to monitor traffic violations, how do you rate your support for the use of video surveillance cameras on the streets of Alberta's cities and towns?	2003
	How concerned are you about the ability of new surveillance technologies such as surveillance cameras, the internet or computer databases to monitor your actions?	2003
	How concerned are you about crime in your neighbourhood?	2003

Appendix E. Beta Values for All Variables Included in the Regression Analyses

Table E.1. Beta values and significance levels for all dependent variables across all control variables

Dependent Variable	*Control Variables*								
	Sex	**Age**	**Years of Schooling**	**Marital Status**	**Urban/ rural**	**Household Size**	**Home Ownership**	**Income**	**R^{2}**
Health Issues									
Long-term care regulation (2005)	.11**	-.02	-.02	.03	-.09*	-.05	-.02	-.05	.01
Long-term care subsidies (2005)	.10**	.03	-.00	-.03	-.03	-.01	-.06	-.02	.01
Physical activity (2005)	.00	-.15**	.10**	-.00	.06	.03	.02	.12**	.06
Social Issues									
Funding for public education (2002)	-.07*	-.06	.12**	.06	.04	.08*	-.07*	.06	.03
Health of democracy (2003)	.06	.05	-.04	-.04	.01	-.00	-.01	-.05	.00
Influence of big business (2003)	-.02	.03	.12**	.01	-.02	-.01	-.04	-.03	.01
Government hides information (2003)	-.06	.09*	.02	-.04	-.01	.06	-.03	-.09*	.01
Support for US war on terrorism (2003)	.12**	.12**	-.13**	.03	-.07*	.10**	-.01	.09*	.07
Openness to immigrants after Sept. 11, 2001 (2003)	.04	-.06	.14**	.03	.16**	-.03	.01	-.04	.05
Welfare recipients (2004)	.08*	-.13**	-.20**	.11**	-.04	.01	-.00	.02	.07
Same-sex marriages (2005)	-.16**	-.27**	.17**	-.00	.13	-.13	.02	.04	.15

Table E.1 cont'd

Dependent Variable	*Control Variables*								
	Sex	**Age**	**Years of Schooling**	**Marital Status**	**Urban/ rural**	**Household Size**	**Home Ownership**	**Income**	**$R^{2\#}$**
Environmental Issues									
Health of environment in Alberta (2003)	.10**	.09*	-.03	-.02	.02	.05	-.03	.04	.01
Influence of environmentalists (2003)	.07	.14**	-.17**	.03	-.11**	.02	-.02	.06	.08
Protected areas (2004)	-.07*	-.06	.03	.03	.05	-.06	.00	.06	.01
Risks from drinking tap water (2005)	-.05	-.01	-.06	-.02	.02	-.04	-.04	.01	.00
Crime-related Issues									
Support for video surveillance (2003)	-.14**	.05	-.07*	.04	-.05	-.08*	-.01	-.01	.04
Concern with new surveillance technologies (2003)	-.06	.11**	.00	-.03	-.03	.00	.01	.02	.01
Neighbourhood crime (2003)	-.04	.11**	-.11**	.02	.14**	.03	-.02	.04	.03
Total # of significant effects	*9*	*9*	*10*	*1*	*5*	*3*	*1*	*3*	

Adjusted R^2

* $p < .05$; ** $p < .01$

Appendix F. Calculation of Weighting Factors for the 2003 and 2005 Alberta Surveys

$$\text{Weighting Factor} = \frac{\text{Proportion of Total Population}}{\text{Proportion of Alberta Survey}}$$

Note: Weighting factors were calculated for the Edmonton region only. Thus, tables F.1 and F.2 present the proportion of the sample (Alberta Survey) or population (census data) falling into each category for Edmonton only.

Table F.1. Calculation of weighting factors for the 2003 Alberta Survey (Edmonton region only)

Demographic Characteristic	2003 AB Survey Proportion (A)	2001 Census Proportion (B)	Weighting Factor (B/A)
Age Groups			
18-24	0.124	0.1442	1.1631
25-34	0.204	0.1927	0.9448
35-44	0.235	0.2286	0.9726
45-54	0.188	0.1933	1.0281
55-64	0.124	0.1097	0.8850
65-74	0.080	0.0783	0.9787
75+	0.046	0.0532	1.1558
Total Years of Schooling			
Less than 9 years	0.015	0.0617	4.1147
9-12 years	0.271	0.4225	1.5590
13-17 years	0.525	0.4195	0.7990
18 or more years	0.188	0.0963	0.5123
Income (Individual)			
< $16000	0.240	0.3472	1.4469
$16000 - 25999	0.173	0.1857	1.0735
$26000 - 35999	0.161	0.1476	0.9171
$36000 - 44999	0.082	0.1002	1.2215
$45000 - 54999	0.100	0.0739	0.7391
$55000 - 64999	0.073	0.0529	0.7247
$65000 - 74999	0.056	0.0316	0.5639
$75000 - 84999	0.029	0.0200	0.6907
$85000 - 99999	0.023	0.0147	0.6389
$100000+	0.062	0.0261	0.4210

Table F.2. Calculation of weighting factors for the 2005 Alberta Survey (Edmonton region only)

Demographic Characteristic	2005 AB Survey Proportion (A)	2001 Census Proportion (B)	Weighting Factor (B/A)
Age Groups*			
20-24	0.1166	0.1062	0.9113
25-34	0.1917	0.2060	1.0747
35-44	0.1995	0.2094	1.0498
45-54	0.2176	0.2027	0.9316
55-64	0.1503	0.1303	0.8671
65-74	0.0777	0.0785	1.0095
75+	0.0466	0.0668	1.4331
Total Years of Schooling			
Less than 9 years	0.0273	0.0617	2.2612
9-12 years	0.1935	0.4225	2.1828
13-17 years	0.6055	0.4195	0.6929
18 or more years	0.1737	0.0963	0.5545
Income (Individual)			
< $16000	0.2610	0.3472	1.3305
$16000 - 25999	0.1349	0.1857	1.3768
$26000 - 35999	0.1584	0.1476	0.9324
$36000 - 44999	0.0938	0.1002	1.0673
$45000 - 54999	0.0997	0.0739	0.7413
$55000 - 64999	0.0674	0.0529	0.7844
$65000 - 74999	0.0411	0.0316	0.7692
$75000 - 84999	0.0499	0.0200	0.4018
$85000 - 99999	0.0293	0.0147	0.5011
$100000+	0.0645	0.0261	0.4046

* Postcensal estimates for 2005 were used to calculate the weighting factors for age (Statistics Canada 2006a).